Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XL. NEW YORK, SATURDAY, DECEMBER 27, 1902. No. 26.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

114 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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ELECTRICAL WORLD AND ENGINEER.

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 27, 1902.

CONTENTS.

Editorial 1025
Exchange of Official Wireless Telegraph Messages Across the Atlantic..... 1028
Important Electrical Combination in Germany..... 1028
Experimental Test of the Pupin System of Long-Distance Telephony. By F. Dolezalek and A. Ebeling..... 1029
December Meeting of the American Institute of Electrical Engineers..... 1031
Storage Batteries in Electrical Supply. By Alton D. Adams..... 1032
The Problem of Small Station Reconstruction. By C. R. Maunsell..... 1033
The Profitableness of Interurban Trolleys..... 1033
Telephone Cables—IV. By Arthur V. Abbott, C.E..... 1034
More Tunnel Trolleys for New York..... 1038
Economic Operation of Electric Irrigation Pumps. By Aug. J. Bowie, Jr.. 1039
The Armature Reaction of Alternators—VIII. By C. F. Guilbert..... 1041
A Universal Patent Examination System..... 1043
Recent Electrochemical Developments. By Clinton Paul Townsend..... 1043
New Telephone Patents 1044
Street Car Travel in New York State..... 1045
Telephone Lines in Village Streets 1045
Current News and Notes 1045
LETTER TO THE EDITORS:
Increasing Output of Motors. By A. Grieve 1047
Digest of Current Electrical Literature..... 1047
New Books 1050
Long-Distance Wireless Communication Without Tuning..... 1051
New Desk Telephone Bracket 1051
DEPARTMENTS:
Financial Intelligence 1052
Commercial Intelligence 1053
General News 1056
Trade Notes 1059
Record of Electrical Patents 1059

ATLANTIC AND PACIFIC TELEGRAPHY.

Mr. Marconi, by dint of the steady persistence that alone enables genius to achieve great results, has now succeeded in transmitting wireless telegraph messages across the Atlantic, between the Canadian Government and King Edward, as well as between himself and the King of Italy. Nothing is lacking to the authenticity of the notable event. This December it is not possible for doubting cynics to challenge the deed as they did the transmittal of the "s" one year ago; or as they also did the existence of the "mythical De Sauty" in the grand old days of pioneer submarine cable work. We do not know whether Mr. Marconi so planned it or not, but to us it is an extraordinary coincidence that the very week that saw the landing at San Francisco of the shore end of the Commercial Pacific cable, and the very month that witnessed the completion of the British Pacific cable, should have recorded this splendid feat of sending etheric messages across the Atlantic. "Thus God fulfils himself in many ways, Lest one good custom should corrupt the world," and so the advance in electrical discovery and application goes on. With Mr. Marconi himself we are far from expecting to see the submarine cable annihilated as a means of communication. It is true that land telegraph lines were being run across Alaska and Siberia at the moment the Atlantic cable succeeded, and have never since been completed; but it would often have been an excellent convenience had they existed. When wireless telegraphy has worried through all the difficulties that still beset it, we may expect a great increase in transmarine telegraphy and a proportionate reduction not possible in the rates while submarine cables are the sole dependence. If 1902 had no further claim to remembrance, this wireless record of its closing month will forever signalize the date in the annals of our race and its civilization.

THE BATTLE OF THE ROADS.

A bill has been introduced in the United States House of Representatives authorizing the appropriation by the Federal Government of the sum of twenty million dollars to build good roads throughout the country. This measure, put forward by Mr. W. P. Brownlow, of Tennessee, a State whose roads are probably as atrocious as those of New York or Illinois, proposes that a Bureau of Public Roads of the Department of Agriculture shall have the spending of this money, co-operating with the road authorities in the various States to secure the beneficial result of furnishing the public with thoroughfares that shall not only be directly useful but shall serve as exemplars.

The proposal to spend so large a sum will naturally arouse criticism and provoke opposition, but it is certainly high time that every authority in the land was enlisted in the effort to improve these arteries of commerce and intercourse, just in the same manner as the River and Harbor bill, in spite of some errors, makes appropriations without which most of our ports and tidal ways would become unnavigable. To-day the French lead the world in automobilism, not because they are any whit superior to us in ingenuity and mechanical ability, but because their governments throughout an era of great steam railroad development have not allowed a superb highway system to degenerate. Hence in the remotest rural commune, the automobile has as smooth a path as on any of the Paris avenues radiating from the Arc de Triomphe. If ever the electric automobile is to succeed it will need better roads, and thus

the selfish interests of many electrical engineers and manufacturers are touched by this proposed legislation. Such a striking measure of internal improvement should give us roads nearly as good as those over which Cæsar's legions swept easily from one confine of the Empire to another, two thousand years ago. Even if the sum proposed is not secured, it is reasonable to hope that the National Government will be enabled to join hands and forces, to some extent, with those who in New Jersey, New England and elsewhere are making straight and smooth the paths of the farmer and the automobilist. We are glad to know that that conservative but progressive body, the Automobile Club of America, is giving the measure its judicious and vigilant support.

THE THIRD RAIL AND SLEET IN CHICAGO.

The recent serious trouble experienced by the Manhattan Railway Company in New York with sleet on the third rail has aroused such apprehension in the minds of some people in regard to the advisability of third-rail electric traction for any heavy railroad work, that it is opportune to call attention to the fact that Chicago elevated roads are now troubled but little with sleet. It was several years before methods were evolved and apparatus perfected for successfully battling with what is probably the most serious difficulty a third-rail electric road has to contend with. Although sleet storms are not numerous in Chicago, they come occasionally with great severity. During the past three years there has been no storm that has seriously interfered with elevated traffic in Chicago.

The different companies do not entirely agree in the methods used, but the whole situation may be summed up by saying that plenty of brushes and scrapers are provided, and they are ready for use promptly during the entire season. One road uses steel wire brushes, bearing on the rail both in advance and in the rear of each contact shoe. These steel wire brushes have flat bristles, and will take care of any moderate sleet storm. The brushes are kept ready for use on each car, but, of course, are only brought in contact with the rail when necessary. Occasionally a sleet storm occurs which is too much for the brushes, and for an emergency of this kind the cars on this road carry steel scrapers, which are used in addition to the brushes. These scrapers are made of a single piece of sheet steel. Another elevated road in Chicago uses instead of brushes a scraper, which is somewhat in the nature of a brush, in that it has a back of cast iron, into which a number of steel plates corresponding to the bristles of a brush are cast. This scraper-brush rests on the third rail, being held down by a spring of considerable flexibility. Of course, the wear is rapid, but as they are not in service much of the time, that is of minor importance, in comparison to keeping the road in operation during a sleet storm.

Part of the trouble of the Manhattan Railway seems due to the use of a guard, or trough, in which the third rail is placed. One of the Chicago roads, when first adopting a third rail, put on a trough of this kind, but abandoned it because of the excellent space it formed for the collection of snow and sleet. Taken altogether, as we asserted last week, there is no ground for serious alarm about the practicability of the third rail in sleet storms. If the New York Board of Health would permit the removal of the guards on the Manhattan Railway short rail, it would no doubt facilitate the operation of the road in the sleet and snow storms very much. It is probably not far from a correct estimate to say that more lives would be lost indirectly in the city of New York in the course of a year through exposure during delays in the elevated traffic, caused by the presence of this third-rail guard, than would be lost through shocks or burns received by employees working on the structure. The frightful discomforts now endured by the New York public means sickness and death to many persons of feeble health. Of course, all overhead wires crossing the track would have to come down. They ought to be down, anyhow.

THEORIES OF MAGNETISM.

In an article which appeared last week Dr. Zacharias presented a particular magnetic theory, according to which magnetism is to be regarded as analogous to hydrostatic pressure. Moreover, it would appear that according to the views propounded, an iron shell enveloping a magnet intercepts the pressure in some manner, and produces remarkable phenomena. To judge by the concluding paragraph of the article, the author of the theory seems to be timorous of launching suddenly upon an unprepared world the violence of this revolutionizing conception. We hasten to assure him, however, that he need have no fear. If there be any truth in the hypothesis he suggests, it will not shatter the pinnacles of the temples of science; nor leave the esoteric world in sackcloth and ashes.

Furthermore, heretical as it may be, we do not see anything in the theory as stated in the article. In the first place, Ampere's theory of magnetism we believe to be a mere working hypothesis, and not a cardinal article of physical belief. We think that few persons, if any, believe that within the molecules of iron actual electric currents perennially circumambulate. But it is quite conceivable that in the atom of iron there are electrified ions performing mutual orbital revolutions about a common electric center of attraction, and such revolving ions would, according to existing theories—the experiments of M. Cremieu notwithstanding—be electrodynamically equivalent to small active electric circuits. In such a manner, Ampere's hypothesis might be promoted from the condition of an interesting mathematical speculation to that of a reasonable physical theory of inherent molecular magnetism.

In regard to the cylindrical electromagnet, in so far as its phenomena are correctly described, these phenomena are satisfactorily accounted for by the existing theory of the magnetic circuit. Some of these phenomena appear to be incorrectly described in the article. If the article is right, then it is of the greatest importance that the discrepancies should be revealed for the sake of experimental science, rather than for the sake of magnetic theory. But until adequate experimental proof is forthcoming, they seem to lie in a slough of inaccuracy. For instance, it is hopelessly inaccurate to say, as the article says, that the addition of the cylindrical shell in such a magnet increases the strength of the magnet from 30 to 36 times. The statement might be correct for the strength of some particular magnet and shell, at some particular distance, measured in some particular way. But one might just as well say that putting a man on a pair of stilts increased his height 1.53 times. Altogether, this "pressure" theory of magnetism has not sufficient weight to convince one.

THE UNDERWRITERS' ANNUAL MEETING.

The annual meeting of the Underwriters' National Electric Association was held in New York on the 9th of December, as already noted. This is the association which, with the aid and endorsement of various engineering institutions, has compiled and adopted the National Electrical Code. The Decalogue contains ten commands usually starting with the imperative "Thou shalt not." The National Code is an improvement, containing about four hundred commands, usually involving the injunction: "Thou must not." An aggregation

of four hundred must-nots is sadly depictive of human nature in connection with untrammeled electrical contracts and installations. An intelligent being arriving for the first time on this planet from another sphere, and reading the National Code, would be apt to become convinced of the utter depravity of electrical constructors. The pages of the code suggest the "eternal nay" of the universe as interpreted, during fits of indigestion, by Carlyle; or the mental attitude of the nursemaid, who told the child immediately beneath her orderly eye, to go out of doors to see what the other children were doing, and to tell them "they mustn't."

Nevertheless, it must be admitted, in all seriousness, that the musts and the must-nots of the National Electrical Code are essentially salutary and beneficent. Electric lighting, when properly introduced, is safer to property and person than gas or oil lighting, besides being more salubrious and convenient. But electric lighting carelessly introduced may be dangerous to property and to person. As long as a man builds himself a house far from his neighbors, and carries his own insurance, there is no desire on the part of his neighbors to dictate the conditions under which he shall install his house wires or fixtures. He may hang a naked arc lamp amid gauzy window curtains, or lead a 1,000-volt circuit through twin flexible cord conductors lashed to the gas pipes. But when he asks his neighbors to insure his house against destruction by fire, his neighbors have a right to declare that his premium for insurance shall be heavy unless he adopts approved fixtures and methods of wiring. It is inevitable that insurance shall necessitate the right to dictate the physical conditions under which the minimum rate shall be assessed.

Much, therefore, as the electrical contractor may resent the interference of the fire underwriters, yet it is better for him to accept the inevitable gracefully and to recognize in the interference a blessing in disguise. For the reduction of fire hazard in all electric installations by following prescribed methods, tends to accelerate the development and spread of electrical industry; while, obviously, the courting of the fire fiend by careless and cheap construction, tends to create apprehension in the public mind. Moreover, the public fear once aroused, with or without raised insurance rates, is far more blind, unreasonable, and difficult to allay, than the censure of the underwriters' experts. Consequently, the censure-dealing underwriter is really the guardian angel of electric enterprise unawares. Turn him ruthlessly out of the door and the municipal heeler armed with boss-bidden ordinances is likely to come in through the roof. The hostility that some central station managers evince towards the National Electrical Code and its framers is futile and must be nugatory in result. It is far better to join hands with the Underwriters' National Electrical Association for the joint purpose of encouraging the most widespread and safest plans of appiying electricity in houses. Whenever a rule is unduly severe, it should be brought up under joint discussion for redress. But all reasonable rules should be enforced as far as possible.

BRAKES AND BRAKING.

The two Institute papers by Messrs. Parke and Keiley, respectively, form together an admirable compendium of the art of braking in theory and in practice. We could wish that the practical effect of bad track and worn brakes had been pushed to an experimental conclusion, but one cannot expect every condition to be taken up in a brief paper, and it is at least as important to know what is the best result that can reasonably be expected. Mr. Parke's paper is an excellent summary of the principles of braking in general with especial reference to the lapses from theoretical efficiency due to misplacement of the brake mechanism and to improper distribution of the brake pressure on the front and hind wheels of a truck. Mr. Keiley supplements this by an experimental study of the actual performance of brakes on fast-running electric cars as found in ordinary electric railway practice. It has long been known that the effective braking of electric cars has proved very difficult, and the long succession of serious accidents which have appalled the public in the last year or two, has served to call forcible attention to the problem. Braking electric cars indeed is far more difficult practically than braking ordinary railway trains, by reason of the frequent necessity for emergency stops to avoid collision with the vehicles or persons excluded from ordinary railway tracks.

The fundamental principle of practical braking is to take up at the brake shoes all the energy possible without causing the wheels to skid. The moment skidding begins not only is the wheel damaged by flatting, but effective braking ceases; so that the art of efficient braking demands that the brake pressure should be kept at all speeds just below the point where further resistance to rotation would produce skidding. This practically means a gradual reduction of the pressure as the car slows down, a feature automatically secured in some of the latest types of air brakes and electric brakes, but very difficult to attain in hand brakes. Actual braking effects can readily though approximately be calculated from the known coefficients of friction between wheel and rail and wheel and brake shoe. This is done in Mr. Parke's interesting paper. It is there shown that in principle it should be possible by the use of sand in bad weather to reach a negative acceleration of just about one-fourth of gravity without skidding the wheels. Now in actual practice this figure is never anywhere nearly reached nor should it be, for it amounts to a reduction of speed of very nearly 5½ miles per hour per second. This is nearly double what is permissible on the score of safety to the passengers, so that we need not regret the evident failure to reach ideal conditions. To tell the truth, a word needs to be spoken on the dangers of too great acceleration both positive and negative, as anyone who has ridden much on some modern electric lines knows to his sorrow. It looks much as if any material increase in brake efficiency would have to be followed by putting the passengers into padded compartments.

Mr. Keiley takes up the practical side of the matter as applied to electric cars, and by a very ingenious apparatus secures accurate automatic records of the action of various types of brakes. In the paper the actual performance of modern hand brakes and of five varieties of power brakes are recorded, and the curves obtained are worth detailed study. Broadly considered, they show plainly that for speeds higher than eight or ten miles an hour, hand brakes are so ineffective that using them implies wilful neglect of the safety of passengers. At fifteen miles per hour a car weighing eighteen tons, loaded, required 150 feet to stop after brakes were signalled—a distance far too great for safety. The best power brakes would bring the same car to a stop in half the space. As between the various power brakes, there were rather large differences, but all were much better than the hand brakes. At low speeds, say eight miles per hour, the hand brakes were relatively better in performance, but were even then hardly adequate. The weakest point of all the brakes tried seemed to be ineffective distribution of the pressure as between front and rear wheels, and proper equalizing gear produced a great change for the better. Perhaps the most striking feature of the experiments was the demonstration of the general inadequacy of any and all braking arrangements to insure safety at the speeds now common on electric roads, unless the track can be kept free of obstructions. Heavy and fast-running cars must be treated along the lines that experience has laid out in practical railroading, irrespective of the motive power.

Exchange of Official Wireless Telegraph Messages Across the Atlantic.

Just a year after he jumped the famous signal "s" across the Atlantic in an experimental way from Poldhu, Cornwall, to St. John, Nova Scotia, Mr. Marconi has publicly succeeded in sending regular messages both ways. This feat will ever render memorable the year 1902 in electrical annals and may mark the definite beginning of wireless transmarine telegraphy as an enterprise. The work of a year ago has been fully recorded in these pages and more recently the work of Mr. Marconi at Glace Bay, Cape Breton, as well as on board the *Carlo Alberto* has been described and illustrated. The *Carlo Alberto* was placed at his disposal by the King of Italy and has been employed in experimental work off the Nova Scotian coast for some time, while the wire antennæ towers at Glace Bay have been under trial. These messages now noted are the first given out to the press, but it is understood that Mr. Marconi had already established all his methods and results before attempting such a veritable tour de force.

On Sunday, December 21, the following dispatch from Mr. Marconi, dated Glace Bay, N. S., December 21, was received at the office of the Associated Press in this city:

"I beg to inform you for circulation that I have established wireless telegraph communication between Cape Breton, Canada, and Cornwall, England, with complete success.

"Inauguratory messages, including one from the Governor General of Canada to King Edward VII, have already been transmitted and forwarded to the Kings of England and Italy. A message to the *London Times* has also been transmitted in the presence of its special correspondent, Dr. Parkin, M. P. G. Marconi."

At the same time, on Monday in London, the *Times* announced that it had received by post from Poldhu, Signor Marconi's receiving station in Cornwall, the following message, sent by wireless telegraphy, from the *Times's* special correspondent at Glace Bay:

"Being present at its transmission in Signor Marconi's Canadian station, I have the honor to send through the *Times* the inventor's first wireless transatlantic message of greeting to England and Italy."

Mr. Marconi also notified Lord Minto, Governor General of Canada, of the achievement and received the following acknowledgment by telegraph from Ottawa:

"Delighted at your message just received. Warmest congratulations on your splendid success. Minto."

Sir Richard Cartwright, Acting Premier, has cabled to England congratulating the British people on the new method of communication between the two countries. A special Marconigram was also sent from Glace Bay to the King of Italy, who immediately forwarded a congratulatory reply to Mr. Marconi.

Replies to messages sent by the Marconi system across the Atlantic were received at Glace Bay on December 22. The inventor was pleased to get one from King Edward VII, which read:

"I have had the honor of submitting your telegram to the King, and I am commanded to congratulate you sincerely on the successful issue of your endeavors to develop your most important invention. The King has been much interested in your experiments, as he remembered that the initial ones were commenced by you on the royal yacht *Osborne* in 1898. Knollys,
"Private Secretary."

The King's reply to Lord Minto's message, sent by wireless telegraphy, was received at Ottawa on December 22 by cable as follows:

"I am much interested by the wireless message which you have sent me and am delighted at the success of Signor Marconi's great invention, which brings Britain and Canada into still closer connection. Edward *R*."

Mr. Marconi is quoted as follows in the *New York Sun* of December 23 as to his great feat:

"When did I first succeed in transmitting messages from Table Head to Cornwall? It was about a month ago. The first messages were all in code and were simply queries such as 'How is this?'

"We would have been in a position to transmit messages much sooner but for delays in obtaining machinery of all kinds. We are, as you can readily see, a good deal out of the world here, and often we had to send as far as Montreal for parts of machinery. This, of course, delayed us greatly. Even after the first message was sent a slight defect was found in one of the instruments and it required two days to remedy this.

"I cannot tell you definitely when we will have our stations ready for commercial purposes. All that is required here is a little organizing, which is merely a matter of a short time. Some time ago, however, the English Government, which controls the telegraph system of the United Kingdom, refused to make connections with the Poldhu station, and this, of course, will have to be done before we can do successful commercial business.

"It was rather amusing," said Marconi, "for us to read rumors of failure in the papers just at the time that our experiments were reaching successful conclusions. Yes, the *Carlo Alberto* sailed yesterday, but it was not before her object in being placed at my disposal had been accomplished and messages had been sent from her commander to the Italian Government during night before last.

"I will remain at Table Head for a short time and then proceed to the Cape Cod station, and from there to Cornwall, to make arrangements for opening for commercial purposes."

Mr. Marconi has sent a telegram to Premier Bond, of Newfoundland, setting forth the complete success of his experiments looking to the transmission of wireless messages between Cape Breton and England. He says he remembers with gratitude the encouragement he received from Newfoundland a year ago, and that he regrets the action of the Anglo-American Telegraph Company made it impossible for him to profit from the colony's attitude.

In his reply to Mr. Marconi, the Premier expressed the hope that when the charter of the Anglo-American Company expires, in April, 1904, Mr. Marconi will establish a fixed wireless station there.

The staff at present at Table Head are Marconi, R. N. Vyvyan, managing engineer for Canada and the Marconi company, and his two assistants, F. S. Stacey and F. Taylor, and two of Marconi's personal staff, P. W. Pagett and G. S. Kemp.

Important Electrical Combination in Germany.

Rumors have been current for some little time past as to a proposed combination of some of the leading electrical manufacturers in Germany, and note has been made of these reports in our columns. A cable dispatch from Berlin of December 22 now makes the following important announcement: The Allgemeine Elektricitaets Gesellshaft, with $22,125,000 capital in bonds, and the Union Elektricitaets Gesellshaft, having $85,000,000 capital, have reached an agreement amounting to a practical consolidation, the directors of each company being elected members of the board of the other, so that the management is identical, though the companies nominally remain separate.

The step is the result of the crisis in the German electrical industry. After the subsidence of the great boom in electrical companies it was found that the manufacturing capacity had far outrun the market's demands, hence various efforts had already been made to organize a combination after the method practiced in America. The Allgemeine took the lead in this effort, but in early negotiations found that most of the other companies demanded too high a rating in the proposed combination. The first offer was made to the Schuckert Company, of Nuremberg, which surprised the country last summer by announcing sensational losses through the shrinkage in value of its securities and plant.

The Allgemeine attempted to secure control of the Schuckert business through a group of great Berlin banks which back the Allgemeine. The banks contemplated effecting a practical combination of the two companies by extending financial support to the Schuckert. The negotiations came to nothing through the refusal of the Schuckert directors to accept the terms offered. The Allgemeine then entered into negotiations with the Union, which were conducted so secretly that the announcement to-day took the market completely by surprise, and its publication caused a rise in Electricals, Allgemeine gaining 6½ and Union 2⅓ points. The Union owns the Thomson-Houston patents for Germany and neighboring countries. The technical manager of the combination is an American, Mr. Louis Magee.

The combination's greatest rival, the Siemens & Halske Company, capitalized at $23,250,000, held its annual meeting to-day and declared a 4 per cent. dividend, against 8 per cent. in 1901. The compa y's report says of the combination that the Siemens & Halske Company is able to go on alone, but after the situation has cleared up a combination may seem feasible.

Experimental Test of the Pupin System of Long Distance Telephony.

BY F. DOLEZALEK AND A. EBELING.

THE Siemens & Halske Company, assisted by the German Imperial Post and Telegraph Bureau, have made a series of elaborate experiments to ascertain the effect of the addition of inductance coils to telephone circuits according to the Pupin system, and the results obtained were so favorable that the Siemens & Halske Company decided to take up the European rights to the Pupin patents. The following investigations were made in order to obtain actual figures with which to test improvements upon which the invention is based.

The initial tests demonstrated, that with the same conductor, i. e., with the same expense, it is possible to telephone over a distance four times greater than is at present possible; and that it would be possible to establish excellent telephonic communication between cities as widely distant as Paris and St. Petersburg, Berlin and London. For shorter lines the use of the system involves, of course, a very considerable increase in economy.

Dr. Pupin has shown in his calculations that locally inserted inductance reduces the damping constant in the same way as a uniformly distributed inductance, when the distance between the inductance sources covers a fractional part of the wave length of the alternating current transmitted over the circuit. This fact is the essential point of the Pupin invention; the tests showed improvement of the speech transmission efficiency of a circuit through the introduction of inductance coils. It being possible to perform readily laboratory experiments with a cable, the Siemens & Halske Company made extensive experiments by this means. The results obtained were such as to encourage the repetition of these experiments on a practical scale.

Through the kind assistance of the German Imperial Post & Telegraph Bureau, who recognized the importance of experiments of this nature and showed great interest in the same, it was possible for the Siemens & Halske Company to perform two series of investigations, one with a cable between Berlin and Potsdam, and the other with an overhead circuit between Berlin and Magdeburg.

The cable between Berlin and Potsdam was manufactured by the Siemens & Halske Company, and laid several years ago for the Imperial Postal Administration. Its object was to relieve the poles between the two cities and take care of the suburban service. It is 20 miles long and consists of 28 double circuits of copper wire 1 mm thick. The copper conductors are insulated by the paper method customary with Siemens & Halske. The cable is laid as a ground cable between Potsdam and the city limits of Berlin, and for this distance it is armored with lead and asphalt. In the city of Berlin it is drawn through the network of conduits as a lead armored cable without asphalt covering.

Fourteen of the double circuits of the cable were placed at the disposal of the Siemens & Halske Company, for the purpose of the experiment. The other 14 were to remain in their original condition. This fact was of great importance for the experiment, as it enabled the investigators to make comparisons between an equipped and an unequipped circuit of same length and otherwise same conditions, with great facility. As the cable was not to be injured in any way, the inductance coils could only be inserted at the manholes. This condition limited the distance of separation. It was decided to use every second manhole, making the distance between induction coils about 4,000 feet.

Each coil had a resistance of 4.1 ohms, being the same for the sending as for the return wire, and an inductance of about .062 henry. The resistance of one mile of line, including coils, was about 37.8 ohms and the capacity had a value of about .059 microfarads per mile. These values give for the dampening factor, according to Prof. Pupin's simplified formula, .01.

The inductance of the normal circuits was measured by means of an alternating current of 900 p.p.s. and was found to be .0005 henry per mile. The resulting dampening constant of the normal cable was, therefore, .06 at 900 p.p.s. Hence, by the introduction of inductance coils the self-induction was increased two hundredfold and the dampening factor reduced to one-sixth.

With this large reduction of the dampening factor a great improvement in the speech transmission efficiency of the line was to be expected and was actually obtained. Comparing the two circuits of the Berlin-Potsdam cable, each 22 miles long, one equipped with the Pupin coils and the other a normal circuit, a most decided difference in loudness was noticed. With the unequipped line speech was not intelligible 20 inches distant from the receiver, whereas over the equipped line it was clearly heard at the opposite end of the room, a distance of 40 feet from the receiver. A Siemens microphone of the type installed on the Imperial post and two Helles cells were employed for these experiments.

There being at the disposal of the investigators fourteen equipped and regular lines, it was possible to increase the length of the line by joining several circuits. Joining 3 lengths of line in this way gave a circuit 66 miles long. Comparison of two circuits of this length, one with coils and the other without, gave results even more marked than when only 22 miles distance was talked over. While it was possible by means of the equipped line to clearly understand speaking even at a considerable distance from the receiving apparatus, the speech transmission limit was almost reached with the regular line.

Joining 5 lengths of cable gave a circuit 110 miles. A trained ear could just detect a sound from the receiver diaphragm connected with the normal circuit, while with the line containing inductance coils a very clearly intelligible transmission was possible.

Almost the same loudness was obtained over five lengths of equipped line 110 miles long as over one length 22 miles of normal line. Intelligible transmission was obtained even over thirteen lengths, or 286 miles of equipped line, but the volume of sound was very small.

An overhead line, between Berlin and Potsdam, of 2 mm bronze wire and of the same length as the equipped line was next compared with the latter. The loudness of speech in both circuits was very nearly the same. The state of the weather had some effect in varying the result a little, in clear weather tending to increase the loudness of the overhead circuit, while in bad weather it was the cable circuit which was the louder. This result deserves special notice, as it was possible by equipping a cable with the Pupin system to obtain the same results as with an overhead line 2 mm in diameter and four times the cross section. Theoretical calculations show that this result was to be expected.

The coil equipment was a very simple one. The fourteen coils were placed in an iron case and their terminals led to a manhole where they were connected to the different circuits of the cable. The cases were then filled in with insulating material.

The cable experiments having proved a success, the Imperial Postal administration then placed at disposal of the Siemens & Halske Company a 2-mm bronze wire overhead circuit, connecting the cities of Berlin and Magdeburg and about 93 miles in length. The service is divided between six intermediate stations. This line could be compared with a 3-mm bronze wire circuit, used for the direct service between Berlin and Magdeburg and about 115 miles long. Before the equipment of the 2-mm line, the distinctness of speech transmitted over this line was, of course, not as good as that over the 3-mm circuit. The 2-mm line was then equipped with the Pupin coils, this being done without interfering with the service. A coil of .6-ohm resistance and an inductance of .08 henry was introduced at a distance of every 2½ miles. Upon the introduction of inductance coils the speech transmitted by the 2-mm line was observed to be much louder than that transmitted by the 3-mm line.

The previously described experiments with speech transmission are qualitative in their nature. To ascertain, also, the amount of reduction of the damping resulting from the introduction of inductance, loaded and unloaded cables were measured by means of an alternating current of small intensity, but high frequency; these are the conditions which are present in a practical telephone circuit. For this purpose alternating currents of 900 and 400 periods per second and a few milliamperes were sent through the cable, and the received current measured by means of a sensitive mirror dynamometer.

It was difficult to duplicate the theoretically calculated conditions whereby only the transmitter is permitted to contain impedance, as the measuring instruments had a perceptible self-induction of their own. It was, therefore, decided to adapt the method as far as possible to practical conditions. Hence, the receiving instrument was given nearly the same impedance, 4 henry and 400 ohms resistance, as that of the microphone. Fig. 1 shows a circuit of observations at 900 periods per second. The initial current in this, as in all the other measurements, was 3.38 milliamperes. As ordinate were plotted the received currents in milliamperes; the length of the

cable in kilometers was the abscissa. Lengths over 32.5 km were obtained by joining together several conductors of the cable. This was permissible as no perceptible induction between the different conductors existed.

Referring to the accompanying curves (Fig. 1), the received current at the end of the line containing inductance coils had a larger value than that at the receiving end of the normal cable. Both curves show plainly the exponential falling off predicated by the theory. A single length of cable, between Berlin and Potsdam, 22 miles long, and equipped with the Pupin system, gave for the value of the receiving current 12 milliamperes; a similar normal cable .17 milliamperes. The received current of the former is thus seven times greater than the latter. According to the theoretical equation, the ratio between the receiving current of the Pupin cable and the normal cable rises extraordinarily in value as the length increases, so that with a length of 66 miles the speech transmission by means of a Pupin cable is forty-eight times better than with a normal cable.

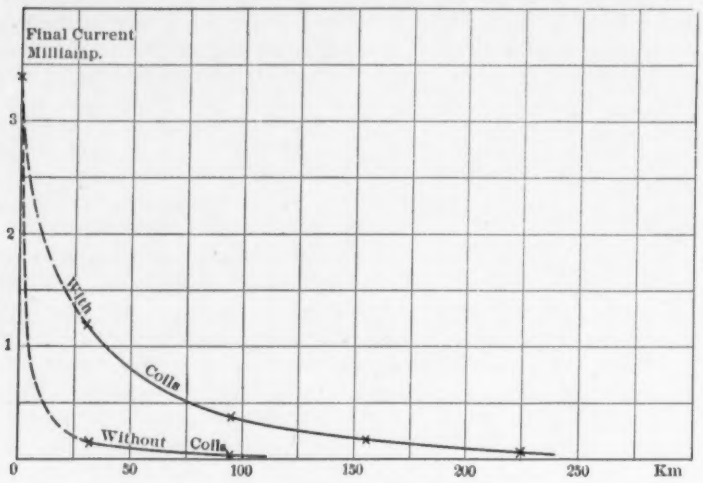


FIG. 1.—CURVES AT 900 P.P.S.

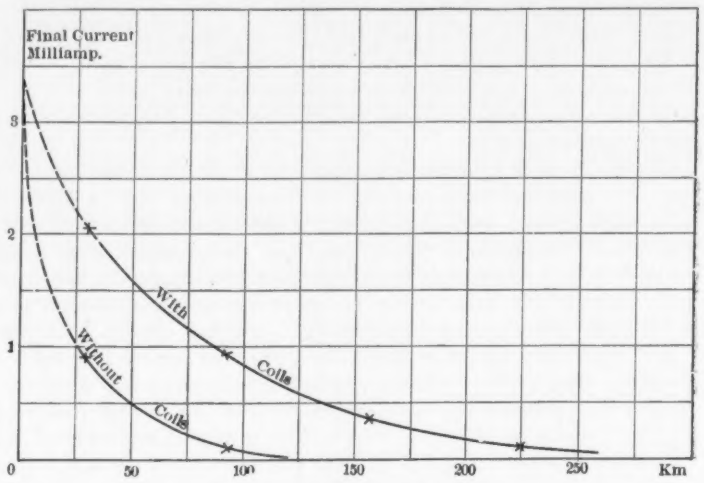


FIG. 2.—CURVES AT 400 P.P.S.

The damping in case of the former with five lengths of cable is the same as with the latter, a result which agrees well with the experimental deductions. These results show the enormous superiority of the cable equipped with inductance over a normal cable.

Fig. 2 gives the results of analogous measurements at a frequency of 400 periods per second. The differences between an equipped and a normal cable are still considerable, although the damping in the normal cable is considerably reduced at low frequencies. Comparing Fig. 1 and Fig. 2, we see that the relation of the damping between frequencies of 800 and 400 p.p.s. of a Pupin cable is 1 : 1.6; of a normal cable, 1 : 6. The cable equipped with inductance coils transmits all sound waves approximately the same and this explains the exceptional clearness of the speech transmitted by this cable.

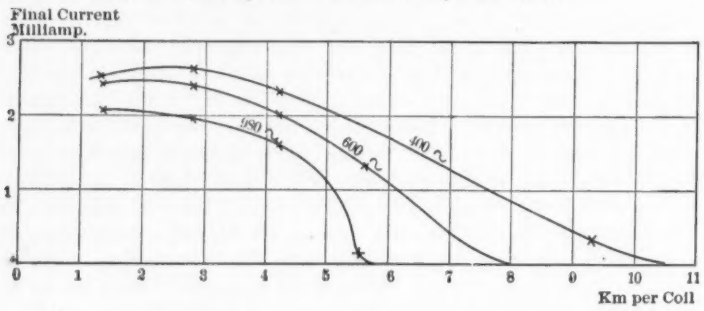


FIG. 3.—RECEIVED CURRENT AT END OF 17.4 MILE CIRCUIT.

The same method and instruments as employed on the cable were used in testing the 2-mm, 93-mile circuit between Berlin and Magdeburg. The circuit was tested before and after equipment. The initial current was again 3.38 milliamperes. The values of the receiving current at 900 p.p.s. are as follows:

93 miles long, 2-mm circuit, without coils.....	.53	milliamp.
do with coils.....	2.20	"
115 miles long, 3-mm circuit, without coils.....	.84	"

The experiments were performed with an insulation value for the lines of about 15.4 megohms per mile. By the introduction of inductance the value of the receiving current of the 2-mm line increased from .53 milliampere to 2.2 milliamperes, or fourfold, and thus considerably exceeded the value for the 3-mm line. The greater length of the 3-mm line is responsible for but a very small fraction of this difference. Naturally with longer lines, as was the result with cables, even far greater improvements can be obtained by the introduction of inductance.

To determine to what extent the current transmission is influenced by the insulation, measurements were made with insulations having different values. These showed that the insulation had a greater influence on the 2-mm line equipped with the Pupin system than on the 3-mm normal line, but even with its low insulation value of .62 megohm per mile, the Pupin circuit was far superior to the 3-mm circuit.

From these measurements it follows that in long-distance transmission with the Pupin system it is possible to obtain, at least, the same efficiency with but one-quarter the weight of copper, or with the same weight of copper, to cover four times the distance.

The essential point of the Pupin invention is, as has been already mentioned, the fact that the added inductance coils are only effective in reducing the damping, when the distance between the coils covers a fractional part of the wavelength of the alternating current transmitted over the circuit. Increasing the distance between the coils brings in a reflection of the wave, while the damping increases rapidly and becomes even greater than that of the normal line.

Experiments on the effect of varying the distance of the coils were made with an ordinary paper insulated cable, 17.4 miles in length and having a copper conductor .8 mm in diameter. The alternating currents employed had frequencies of 980, 600 and 400 p.p.s. respectively. For all measurements the value of the inductance per mile was calculated, being 1.2 henry, and the capacity $C = .064$ microfarad. The resulting wavelengths in kilometers were as follows:

980 p.p.s., 12.9; 600 p.p.s., 21.0.

Twenty coils of .11 henry each were employed for the sending and return circuit, and were distributed between 20, 10 and 5 points respectively. The total inductance was thus kept constant while the coil separation could be varied from 1.4 up to 10 km. The effective initial current was 3 milliamperes.

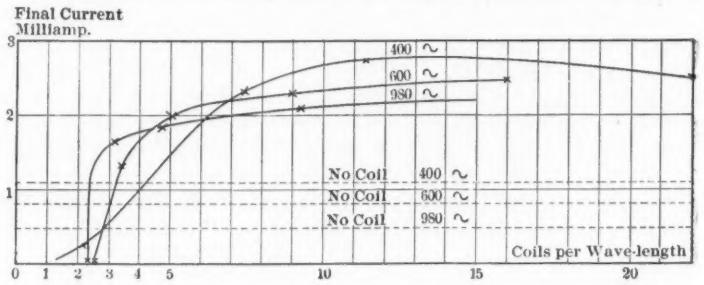


FIG. 4.—RECEIVED CURRENT FOR VARIOUS COILS PER WAVE LENGTH.

Fig. 3 gives the receiving current at the other end of the 17.4-mile circuit at the different frequencies, as a function of the distances between coils.

Beginning with a certain separation distance between coils, the values of the receiving current fall off rapidly, and the higher the frequency the more abrupt is the falling off.

With the distance between coils equal to 6 km and a frequency of 980 p.p.s., the alternating current was totally reflected. Even the most sensitive long-distance receiver was not able to detect any trace

of a sound. Alternating currents of 600 and 400 p.p.s. are completely choked when the inductance coils are separated distances of 8 and 10 km respectively. As the distance between coils increases, therefore, a successive filtering out of the different frequencies takes place. This was foreseen from the theoretical deductions.

Plotting the receiving current as a function of the number of coils per wave length the following results are obtained (Fig. 4):

Between 2 to 6 coils per wavelength, the received currents at all frequencies reduce to zero. With two coils per wavelength, therefore, we have reached a critical limit; a lesser number of coils will result in a complete choking out at all frequencies and hence make telephoning impossible. Concentrating the inductance at successive individual points gave very interesting results. Where properly inserted the inductances gave an exceptional clearness of speech; too large a separation of the coils resulted in a completely indistinct, confused noise.

These experimental tests demonstrate that the introduction of inductance coils into long-distance telephonic conductors in accordance with Pupin's invention, realize in practice the enormous effects indicated by theory; and as a consequence long-distance telephony is enabled to enter a new era of development. The problem of transatlantic telephony has through this invention become a possibility, even if the cost of an ocean cable of this kind be yet too high; and the technical difficulties accompanying the manufacture and laying of a submarine cable in great ocean depths with coils must be considered as exceptionally serious. But for the less considerable depths of the Mediterranean, North and Baltic Seas, the manufacture and laying of a Pupin cable presents no difficulty, so that there is nothing in the way of establishing direct telephonic communication between Berlin-London, Berlin-Copenhagen-Stockholm, etc.

December Meeting of American Institute of Electrical Engineers.

At the meeting of the Board of Directors of the American Institute of Electrical Engineers, held on Friday afternoon of last week, 52 associates were elected. At the regular monthly meeting two papers on railway braking were presented, notices of which appear below.

In introducing the papers, President Scott referred to the difficulty of the braking problems now being encountered in electric traction through the growing use of higher speeds and heavier cars. In electric service in elevated and underground city railways where stops are frequent and high schedule speeds are essential certain new elements have entered into the braking problem. Ordinarily brakes are for the purpose of facilitating traffic and preventing accident. The new feature of commercial value which has come into the problem is that of quick retardation. The run from one station to the next consists in acceleration, running at a sensibly constant maximum speed, and retardation. To increase schedule speed it is important to lessen the time of retardation as well as that of acceleration. This is a new demand. It presents a new point of view in braking problems which have not previously been of importance in regular service.

This is illustrated by the marked difference in schedule speed under average conditions such as prevail on the elevated railways of Greater New York between a low rate of braking and quick retardation. A change in the rate of retardation from 1 mile per hour per second to 3 miles per hour per second increases the schedule speed about 10 per cent. This effects a saving in time to the passengers of 10 per cent, and it reduces the number of trains required for carrying a given number of passengers by 10 per cent.

President Scott then gave a classification of brakes and described the main features of the different methods of electric braking, and pointed out the extreme flexibility of electricity in its application to problems of this kind; but the application of the braking effect in proper amount at the proper time and with a reliable method of control places very exacting requirements upon the designer of braking appliances.

In a paper entitled "Railroad Car Braking," Mr. R. A. Parke gave a sketch of the practical development of brakes in railroad service, which included an analysis of the results of investigation of brake-shoe friction; a definition of the requirements and limitations of brake efficiency in practice, and a consideration of the loss of braking efficiency through disturbances of the normal rail pressures by brake retardation, and the means of compensating for the same.

The paper discusses the data relating to friction, and gives formulas for calculating the several values necessary to be known in connection with braking. The design of a truck brake gear is briefly considered, and the conclusion arrived at that by the use of inside-hung brake beams, where sufficient inclination of the hanger links insures brake-shoe clearances through the action of gravity, both the expense and trouble due to the use of release springs is avoided. The latter portion of the paper is devoted to the magnetic brake, and the conclusion arrived at is that the efficiency of the magnetic brake under the various conditions of service is phenomenal, far exceeding that of any other brake for the retardation of trains; this, combined with the commercial advantage of dispensing with the use of trolley current, or any other means of heating cars, is considered to assure it a leading position in the railway operation of the future.

Mr. J. D. Kiely, in a paper entitled "Some Brake Tests and Deductions Therefrom," gives an account of braking tests with cars of from 15 to 25 tons weight (including passenger load) from speeds under 30 miles per hour. Full details of the methods of test are given, together with the formulas employed and the data obtained. A comparison of all the data, including costs, of several types of brakes showed that under certain conditions a very considerable amount per annum may be saved by the judicious selection of brakes. A practical result of the tests was the application of a system of differential levers to hand brakes, and another to power brakes; in the latter case the distance required to stop a car was reduced by approximately 18 per cent. through the use of non-equalizing levers applying to the front truck a braking pressure exceeding that applied to the rear truck in a certain predetermined ratio.

The discussion which followed was participated in by President Scott and Messrs. Mailloux, Stott, Lyford, Foster, Townley, Gotshall, Ries, Smith, Hammer, Franklin and Esty. The difficulty of laying down definite expressions to predetermine frictional effects was dwelt upon, especially by Mr. Mailloux and Prof. Franklin, the former as a result of a study of the practical data and the latter from a consideration of the nature of the phenomena entering. President Scott pointed out that the failure has been due to the application of mathematical methods without due consideration as to whether the assumptions they involved were justified by the nature of the phenomena. Mr. Townley cited a test made on the Boston elevated, where a three-car train running at a speed of 35 to 40 miles per hour had the emergency brakes applied with power lift on the motors; the result was that the train slowed down to 20 miles per hour and then maintained that speed, showing that with all the cars equipped it was not practicable to stop the train with brakes.

Mr. Townley favored placing the brake shoes of electrically equipped trains between the wheels, for the reason that with such an arrangement the brake-dust is thrown away from the electrical equipment, while with the brake shoes placed on the outside of the wheels, the reverse is true. Mr. Gotschall was of the opinion that more trouble will be experienced with the arrangement referred to than with outside brake shoes. He considered an explanation for the higher efficiency of the power brake is that it eliminates the motorman as a personal factor; hand brakes are set up a great portion of the time when power is on, while the motorman with power brakes throws off his power before setting the brakes. Mr. Parke, in reply to an inquiry, said that the experience of steam railroads is that inside-hung brakes are the most satisfactory. With high-speed brakes the shoes wear out somewhat more rapidly, but there has been no complaint of excessive shoe wear; it is true that such brakes introduce an additional piece of mechanism, but this requires very little attention. In reply to a question as to whether there was an increase of frictional effect incident to the use of the magnetic brake, Mr. Parke said that no attempt had been made to determine if the magnetism changed the coefficient of friction.

Mr. William Nelson Smith described some experiments which confirmed the statement that the pressure of the forward wheels on the brake shoes is greater than the pressure of the rear wheels. Mr. Hammer called attention to the use by Edison of a magnetic brake on his 1880 electric locomotive. Mr. Herman H. Westinghouse confirmed the views expressed that the problem of braking is an indefinite one, and with respect not only to the physical phenomena but the personal equation of the users of the apparatus. In the experiments with the Westinghouse brake this latter element is one of the factors receiving a full share of attention.

Storage Batteries in Electrical Supply.

By Alton D. Adams.

MAXIMUM loads, energy outputs and the efficiency of storage batteries determine their utility in systems of electrical supply. From these factors the investment in batteries per unit of their greatest load and the fixed charges per unit of their energy output may be determined. These important relations are better studied as they actually occur in existing systems rather than on mere assumptions of what could or should be done.

To illustrate the practical results that may be obtained with storage batteries, the following data as to their operation in a large system of electrical supply during a period of more than three years are presented. During the earliest of the three years in question a large part and during the two later years the larger part of the electrical output of this system was derived from water power. This fact is important because water power usually increases the utility of storage batteries, which may be used to deliver the energy of the night flow at times of maximum load. In the electrical supply system here considered the load was well divided between street and commercial lamps and stationary motors, but no electric cars were operated by it.

The battery in question consisted of 140 cells of standard make, and each cell had a capacity of 17,000 ampere-hours, giving a total of 2,380,000 ampere-hours' capacity. At an average discharge pressure of 2 volts per cell the battery thus had a capacity of 4,760 kw-hours. On a ten-hour rate of discharge the battery would deliver 476 kw, and on a five-hour rate 952 kw. On an average week day of each month during 1901 the maximum rates of battery charge and discharge, also the ratio of battery discharge at its highest rate to the maximum load of the electrical system were as follows: For the months of June and July the ratios of maximum battery loads to maximum station loads are not given because these loads did not nearly coincide in point of time.

	Maximum kilowatts battery charge.	Maximum kilowatts battery discharge.	Percentage of maximum battery discharge to maximum loads on the system.
January	390	520	19.1
February	240	970	39.2
March	280	240	14.2
April	330	300	17.0
May	330	300	17.4
June	200	200	....
July	150	200	....
August	210	440	27.1
September	360	270	15.3
October	360	400	16.2
November	240	330	13.5
December	340	340	11.9

The highest charging rate for the battery during the year was only 390 kw, corresponding to the battery discharge on a 12.2-hour rate. The highest discharge of the battery was 970 kw in February, amounting to a 4.9-hour rate. In the other months of the year the maximum rate of discharge was constantly above 9 hours, and for the greater part of the time above 14 hours. The battery thus worked much below its maximum capacity both in charging and discharging, a condition favorable to high efficiency. During the twelve months the highest load on the electric system for an average day was 2,840 kw, and of this load the battery capacity at a five-hour rate of discharge was 33 per cent., yet the battery actually carried only 11.9 per cent. of the maximum load. In February, when the battery carried 39.2 per cent. of the maximum load on the system, the discharge rate was 4.9 hours, and this percentage was the largest carried by the battery in any maximum load. In only one other month, August, did the battery carry more than 20 per cent. of the maximum load on the system. As a five-hour rate of discharge for a battery at the time of maximum load, is within the limits of good practice, it is notable that the battery in the present case reached this rate in but one month. The battery capacity being at command, but to a large extent not used during eleven months of the year, raises the natural inference that the station management found it cheaper to operate engines or water wheels and dynamo at the time of maximum load than to charge and discharge batteries. Service from the battery extended over the last three months of 1898, all of 1899 and 1900, and all except the months of June, July and December, in 1901. During this entire period the extent to which the battery has been used has been in general on the decline. Thus in the last quarter of the year of 1898 the battery discharged 103,800 kw-hours, during 1899 about three times and during 1900 a little more than twice this amount of energy, while the record for nine months of 1901 shows a discharge of only 165,487 kw-hours.

Year.	Months of Year.	Kilowatt hours battery discharge.	Percentage of battery discharge to total station output.
1898	last 3	103,800	7.6
1899	12	317,798	5.4
1900	12	222,355	3.0
1901	9	165,487	2.5

The decreasing extent to which the battery has entered into the operations of the electrical supply system is still further brought out by the percentages of battery discharge to total station outputs in kw-hours. Thus, in the last three months of 1898 the battery supplied 7.6 per cent. of the entire output of the system, in 1899 and 1900 the like percentages for the battery were 5.4 and 3.0 respectively, and during 9 months of 1901 the battery discharged only 2.5 per cent. of the entire station output for the same period.

Viewing the years of 1899, 1900 and 1901 as to percentages of battery discharges in each month, it seems that the extent of battery use has varied but little with the time of year. The decline in the monthly use of the battery extends with slight breaks from January, 1899, to December, 1900. Percentage of battery discharge to total kw-hours delivered by the system in each month.

	1899 Percentages	1900 Percentages	1901 Percentages
January	6.9	3.6	2.8
February	5.7	3.1	2.7
March	6.5	4.0	2.0
April	6.3	5.1	2.6
May	6.2	2.5	1.8
June	5.2	2.8	..
July	5.5	1.8	..
August	4.7	1.3	2.5
September	4.3	2.4	2.6
October	5.5	3.9	1.8
November	4.4	2.8	4.0
December	4.6	2.5	..

During 1901 the percentage of battery output shows no regular increase or decrease from month to month. In the three months of this year for which no figures as to percentage are given the battery is believed to have been in use, but the data of charge and discharge are not available. As far as can be learned, the decline in the use of this battery is due to no special circumstances, but simply to the idea that its employment to a greater extent would not pay. For the electrical supply system that includes the battery, the number of kw-hours delivered during 1901 was 1.4 times that delivered during 1899, so that the smaller use of the battery is not due to a decrease in the station output.

Efficiency of this battery, measured by the ratio of kw-hours of discharge to kw-hours of charge in each year, shows a material falling off during the period in question. For the last three months of 1898, when the battery was new, the efficiency was 75.6 per cent., but in the nine months of 1901 the efficiency was down to 64.6 per cent. This loss of efficiency is the more notable because of the moderate rates at which the battery was charged and discharged.

	Battery charge kilowatt hours.	Battery discharge kilowatt hours.	Battery efficiency.
3 months 1898	137,209	103,800	75.6
12 months 1899	463,433	317,798	68.5
12 months 1900	318,479	222,355	69.8
9 months 1901	255,824	165,487	64.6

From these figures it appears that the efficiency of the battery declined eleven per cent. during a little more than three years. At a price of $20 per kw-hour of rated capacity this battery of 4,760 kw-hours would have cost $95,200. During the year of 1900 the battery discharge was 222,355, so that there was 43 cents invested in the battery for each kw-hour delivered by it, on this basis of cost. Allowing 15 per cent. of battery cost for annual interest, repairs and depreciation, these charges would have amounted to 6.4 per kw-hour delivered by the battery during the year named. Facts similar to those stated here no doubt have a bearing on the failure of American central station to adapt storage batteries more rapidly.

The Problem of Small Station Reconstruction.*

BY C. R. MAUNSELL.

The majority of central stations in Kansas, and in other States as well, have not paid the returns on the investments that were expected, and in a great many cases the reason has been that the machinery installed was not suited to the conditions of operation, and the lack of knowledge of the proper business methods. The usual scheme has been about this: The promoter of the plant first gets the idea that an electric light plant would pay well in his town; he talks the matter over with his associates, and they all agree it would; not one of them, however, knows anything about the business. The next move is to find out what the cost would be, and some supply house or manufacturer is asked to pay them a visit. The best salesman is sent; he knows very little about the operation of a plant, but can sell goods. His first effort is to find who knows what is wanted and who is to buy the equipment. When this is ascertained, he generally finds they want information more than anything else, and being a good salesman he gives them all he has; in other words, he lays out the plant, except the boilers and engines, as every one connected with the scheme knows just what is here required. In this part the most expert advice is necessary, as right here lies the success or failure in the lighting or power business. Having made a good guess at the start of a plant, let us see the results. The conditions are as follows, taking one small plant for an example:

The town has 5,000 to 7,000 population, and the city fathers have agreed to take 15 or 20 arc lamps at a rate paid by some other town, with water power to operate the machinery or other great difference in the cost of fuel.

The number of incandescent lights for commercial use have been decided as 1,000, all within an area of 2,500 feet from the site of the station; the residence supply has not been taken into account, as the salesman said this could be taken care of after the plant was started. No power load was considered as being a possible source of revenue, therefore the plant would only be in operation from 6 to 12 hours at the most. Anyone wanting a day service had to do without it.

We are now ready to build; the site is bought, a building is planned and built, and we are ready for the machinery. The mechanical man of t he scheme selects one boiler of 100 horsepower capacity, one pump for feed water and, maybe, a heater. The engine is his next care. He knows nothing of steam as measured in pounds, so any old engine that is well recommended by the salesman will do.

It may be that coal costs $1.50 to $4 per ton, but the engine is the same in either case, for it must be a cheap engine, as capital is limited. The electrical salesman has found this out also, so he sells an alternating generator of high speed and an arc machine of as many lights capacity as he can get money for; no wattmeters are wanted, so the consumers can have all the light they can get while the plant runs.

The consumers have agreed to wire for the incandescent lights, so that expense is out of the way; but arc lamps may be wanted in stores, as every arc machine is sold with the full number of lamps included, the expense for wiring will be a small cost.

In short, the plant is completed and in operation; the engine man, boiler man and electrical man have their money and are gone. The mechanical man is left in charge; the plant apparently runs all right, and all are pleased with the new enterprise except the man with his money invested. He is anxious to know the results the first year, which soon passes, and he is called on for about 50 per cent more than he wanted to put in the plant, but he must go on or lose all, so he puts up or gets his friends to. But all this happened 10 years or so ago, and is forgiven, as there was no one who knew much about the business at that time.

Mr. Maunsell suggested that at this juncture a proper expert engineer be called in. In the plant cited above his first care would be the site for the station, then the electric machinery, which would serve all classes of service from one set of generators. Next, can steam heating be made to pay? This brings up the power supply, which means 24 hours' service to all, with increase of revenue from lighting customers, to say nothing of winds and fan business. He has decided heating can be made a success, and his boilers and engine must be selected for this service. Three new 75-hp boilers, suited for the water to be obtained and set from what experience has proven as the only proper way (in good brickwork on a foundation supplied with good draft); a pump with an injector for emergencies, with feed water heated to the boiling point.

The coal cost is $4 per ton, so the engine that is guaranteed to operate on the least pounds of steam per horse-power-hour is purchased; in this case, two 75-hp Corliss. As back pressure is carried in winter, the horse-power is rather high, but one engine will do the load in summer and mild weather, leaving you a reserve engine, which is a guarantee to the consumer that you mean to take care of him at all times, and he relies on you and gives you his power and heating business also, which enables you to make the necessary investments for such a plant, which is a credit to the town.

The next step is the generating machines. Two 60-kw direct-current at 250 volts is the selection, belted direct, and each with a wattmeter to give the amount of current made, so you will know how to sell it at different times of the day and night, by meter only, except to the city street lights, which are controlled from the switchboards in the station. The consumer will buy his arc lamps and pay for the wiring, if he can get current at living rates, should you put the proposition to him in the right way; the engineer will tell you how to do this.

A change from the first plant outlined to the last one would convince anyone of the economy in operation and the possible revenue to be obtained, in towns of 5,000 to 7,000 population, when it is considered that the last plant is earning a revenue every hour of the day and night, therefore, much more useful to the owners and public.

Taking an estimate of cost for each plant with the revenues and expenses, the above figures are given.

Plant No. 1.

Cost	$15,000
Revenue, per annum	6,000
Expenses	4,800
Net	$1,200

8 per cent. net on investment.

Plant No. 2.

Cost	$28,000
Revenue from lighting	9,000
Revenue from power, fans and day lighting	3,500
Revenue from steam heating	5,000
	$17,500
Expenses	11,000
Net	$6,500

23 per cent. net on investment.

* Abstract of a paper read at the last meeting of the Kansas Gas, Water and Electric Light Association.

The Profitableness of Interurban Trolleys.

We have recently called attention to the brisk controversy over the profitableness of interurban trolleys, that has sprung up in the columns of the *Wall Street Journal.* The one contention is that such roads are over-capitalized; the other side is that their earning capacity is understated, and is not yet by any means fully developed. We have already quoted the arguments pro and con, and now add later ones:

Messrs. Tucker, Anthony & Co., who have built and managed more interurban properties than any other firm in New England, say in regard to this matter: "Mr. Lisman gives the cost of an interurban road, $18,000 per mile; it would be just as appropriate to say that a house costs $5,000. We could name roads that have cost $10,000 per mile, and others even up to $100,000 per mile; all depending upon the character of construction and the difficulties to be overcome. The modern high-speed interurban road of the middle West built upon a private right-of-way, 50 feet in width, is a very different proposition from the Eastern street railway with which the public is most familiar. The construction of these Western roads, with their 70 to 80-pound rails, 8-feet ties, steel bridges, etc., is in all

respects as good as the standard steam roads. The electric road has the additional cost of a very expensive overhead construction, and its frequent schedule requires a large number of cars for regular service, with an equal number of cars for summer use; these cars are usually 50 to 60 feet in length, costing the same as the best class used on the steam roads, and must all be equipped with expensive electric motors and air brakes. Added to all this cost is the power house and its equipment generally of the three-phase, high-voltage type, and its accompaniment of sub-stations scattered over the line. On such roads a regular schedule of 40 to 50 miles per hour is usually maintained.

"As to the earnings, there are, no doubt, all over the country undesirable roads in ill-advised locations and built by inexperienced people, but the interurban roads as a class should not be condemned on this account. Mr. Lisman gives the average earnings as $3,400 per mile. A study of the reports of interurban roads in the middle West will show that the earnings will average over $4,000 per mile of track, and in individual cases are, of course, very much higher. The net earnings will vary according to circumstances; it requires good judgment to locate a road, and also experience and ability to operate for the best results, and each proposition should be judged on its own merits. A study of the electric roads, for a period of ten years back, reveals a history of growth and prosperity that is almost fabulous, and yet the croakers of ten years ago were just as positive of coming misfortune as are the croakers of to-day. We think we could name some steam roads which will be much more liable to go into bankruptcy than the good interurban roads of the type we have referred to above."

In reply to his critics, Mr. A. A. Lisman, of Lisman, Lorge & Co., says: "The correctness of the figures submitted by me in an interview has been questioned as far as results obtained in the middle West are concerned. I, therefore, call attention to the following figures, showing that net results, after proper charges for maintenance of road-bed and equipment, are deducted from the so-called net earnings of Ohio Interurban Street Railways, and do not differ materially from those shown by New York State corporations pursuing a similar business. As examples might be cited the following properties, which are among the oldest and most prosperous in Ohio:

"The Cincinnati, Dayton & Toledo line of some 80 miles showed, in the year ending April 31, gross receipts of $353,000, operation expenses of $186,000, a net of $166,000, fixed charges of $175,000, showing a deficit of some $8,000. As operating expenses are charged with 52 per cent of the gross receipts, certainly no provision is made for maintenance of way and equipment. The expense of maintaining a motor car, including burnt-out armatures, repainting of car, replacing of trolley poles, etc., amounts to over $300.

"The Cleveland, Elyria & Western road, also running some five years, shows similar net results. The operating expenses in this case are 54 per cent of the gross earnings per mile (a 90-mile road), being at the rate of about $290,000 a year. Cleveland, Painesville & Eastern, on 42 miles of road, shows gross earnings of $144,000, and a net, after fixed charges, of $11,000, or less than $300 a mile.

"In this connection Mr. Cornelius Vanderbilt in this month's *North American Review*, comparing the earning power of interurban street railways with steam railroads, arrives at the same conclusion—that is, that maintenance of way and equipment of a street railway will amount in the end to about the same as for a steam road. My figure of $1,000 per mile would, therefore, seem to be even below a proper charge for these expenditures. This average charge for maintenance of way and equipment of roads east of Chicago amounts to fully $1,500 a mile. To put the whole question in a nutshell, it looks very much as if the capitalization for the last year or two of interurban street railways practicaly amounted to the issuing of new capital under the pretence of paying for extensions and improvements, but really for the purpose of paying for repairs and maintenance."

Continuing his discussion of the subject, Mr. Alfred M. Lamar writes: "In his second communication upon the question of interurban railroads, Mr. A. A. Lisman cites individual cases to sustain his position, and shows that one road is being operated for 52 per cent. and another for 54 per cent. of gross receipts. These figures confirm my contention that 55 per cent. is ample for the cost of operating. He gives the gross receipts of the Cincinnati, Dayton & Toledo Traction Company as $353,000. The facts in this case are that this figure represents the gross receipts of the Southern Ohio Traction Company, now composing a part of the consolidation known as the Cincinnati, Dayton & Toledo Traction Company. The Southern Ohio Traction Company at the date of the receipts given operated from the heart of Dayton to College Hill, one of its suburbs and situated ten miles from Fountain Square, Cincinnati, a distance of 52 miles, owning side tracks and double tracks 79 miles. The receipts of this road were $6,788 per mile of road. Observe that I am not prognosticating as to what the future will be.

"The figure named as 'the expense of maintaining a motor car, including burned-out armatures, repairing of car, replacing of trolley poles, etc., amounts to over $300,' is, I think, too low. But I will again call his attention to the fact that such items do, and must of necessity, go into operating, for the reason that a road cannot be operated while its armatures are burned out, or trolley poles and cars out of repair. Mr. Cornelius Vanderbilt is cited as an authority upon the cost of maintenance to sustain his position, and he again says that the cost of 'maintenance and equipment of roads east of Chicago amounts to fully $1,500 a mile,' but does not say whether this refers to steam or electric roads.

"A few years ago a very able paper was read before the American Street Railway Association, in which the statement was made that the average life of a steam locomotive was ten years and that the average life of an electric motor was twenty-five years. The last statement was a mere estimate as at that time no motors had been in use for as long a time. All the wearing parts of a motor are interchangeable and are constantly renewed just the same as car wheels, and it is a fact that many of the first W. P. single-reduction motors put in use about 1892 are in use to-day, and show no signs of depreciation where properly cared for.

Chicago Meeting of the A. I. E. E.

The next Chicago meeting of the American Institute of Electrical Engineers will be held Tuesday evening, December 30, 1902, at the rooms of the Western Society of Engineers, in the Monadnock Block. The meeting will be held eleven days later than the New York meeting for December, in order that Chicago members may have opportunity to receive all the papers in advance. There is promise that some features special to the Chicago meeting will be brought up. As the subject, "Braking and Traction Brakes," is one of general interest, and as interest in the Chicago Institute meetings is being greatly revived, a large attendance is expected. Local Honorary Secretary R. H. Pierce, Manhattan Building, Chicago, can furnish those so desiring with advance copies of the papers and with further particulars in regard to the Chicago Institute meetings.

"Telephonitis."

A correspondent writing to the *New York Times* recently says: "In your edition of Sunday, December 14, you published an account of some modern maladies which have been discovered through the cleverness of the author of the article referred to. I was much surprised to find that in your "medical researches" you have not mentioned "Telephonitis," which is a widespread disease among business men in the down-town district; its first symptom is an irresistible desire to reach the telephone and to ring up "central." A person seriously affected by this treacherous malady, which, by the way, is contagious, will stand by a telephone for hours and call various numbers to the great discomfort of the telephone operator. Finally the person so affected will get into a frenzy, and in wild anger demand the "manager." When the manager, breathless, reaches the receiver, he will have to listen to the most serious accusations, which would justify him in discharging the entire force of the "central." The person who has telephonitis is remarkably always in the right, always gives the correct number, always has carefully listened, and the fact which makes his malady most unpleasant for himself and all others is that he can never get the party whom he calls up. In the first stages of this malady a slight electric shock from the receiver is generally sufficient, but while the disease is progressing the individual so affected gains in courage and impudence and manages to get a monopoly over the particular telephone in the office, which creates a revolution among his co-employes. The only method to treat this unfortunate disease seems to be a large dose of "club-him" three times a day.

Telephone Cables—IV.

BY ARTHUR V. ABBOTT, C. E.

OFFICE ENTRANCES.

TO carry the underground wire plant into the central office it was customary to tunnel under the street, from the end of which the various ducts diverged. The sides and roof of the tunnel were provided with racks set about 3 feet center, on which the cable were supported. Such a method is shown in Fig. 29. Modern practice cheapens construction by omitting the tunnel, and continuing the underground conduits into the basement of the office building, or even in cases where the distributing board is placed on an upper floor the walls of the building are formed of hollow brick and the underground cable continues uninterruptedly to the wire chief's room. Whenever there are corners to turn either a manhole for the purpose must be built to give access to all cables, or else iron pipe bends, of about 5 feet radius, must be introduced into each duct through which the cable can usually be drawn.

Office entrances for aerial cable are as varied and numerous as there are exchanges. The most common method is to plant a distributing pole in front of the building to which all lines, both open wire and cable converge. Cable heads are placed here and all lines cabled and run through a hole in the building wall. A good example of this type of construction is shown in Fig. 30. A still more modern method, when the plant is entirely composed of aerial cable, appears in Fig. 31. In Fig. 32 an unfortunately far too common example is found. Up against the office wall any old pole is erected. To this all the circuits, cable, strands, and open wire run as best they may. The wire chief punches out a few bricks from the office wall and drags through the crevice a handfull of okonite to serve as office cable. Result, endless complaints. Yet this is a photograph from recent work of one of the Western Independent Companies that six months ago, in convention, voted that *"the maintenance of a telephone plant should not exceed 5 per cent per annum!"*

THE QUESTION OF ELECTROLYSIS.

Prior to electric railway days, telephones were universially provided with grounded circuits, but the return currents of trolley roads caused such lines to become unbearably noisy, and a long and bitter warfare was waged between the telephone interests and the street railways, with the view of forcing the latter to abandon the rail return. In this contest, the telephone companies were universally defeated, for it was impossible for a single industry to advance any just claim to demand the exclusive use of the earth as a return circuit.

Shortly after the victory of the street railways a number of cases of corrosion of water pipes, gas pipes, and the lead sheaths of telephone cables, made their appearance, that on investigation were conclusively found attributable to the electrolytic action of railway currents. Armed with this discovery, the telephone companies returned to the fray, and became almost hysteric in their assertions of the immediate and inevitable destruction that menaced alf metallic underground structures. It was confidently asserted that every gas and water system in the country, together with the elevated railway structures and metallic foundations of modern buildings, was not only in danger of destruction, but that already incalculable injury had actually been inflicted. So plausible were these specious assertions, and so skillfully advanced, backed with scientific authority of weight, as to create at least a newspaper panic against the single trolley system. Continued investigation and wider experience proved that the alarmists had, to say the very least, grossly exaggerated the probable danger. The actual facts as they stand to-day may be summarized as follows:

First, when an electric current passes *from* the earth to a metallic body imbedded therein, there is no injurious action.

Second, so long as the current traverses the metallic body, no injurious effect is produced.

Third, when the current leaves the metallic conductor, and reenters the earth, injury may, but does not necessarily take place.

Fourth, when injurious action does take place, it manifests itself as a corrosive pitting of the surface, and substance of the metal as exemplified in Figs. 33 and 34. Fig. 33 being a piece of lead service water pipe, and Fig. 34 a bit of the lead sheath of a telephone cable. This action results in a number of perforations of the metal, and may even spread so far as to cause a widespread destruction.

Fifth, a very small difference of potential between the metal and the earth (a hundredth of a volt) may be sufficient to cause an injurious action which will be cumulative, and will in time result in extensive destruction.

Sixth, it is easy to locate danger areas, and to provide protection by leading away the pernicious currents by some conductor that is not injured thereby.

Seventh, various metals exhibit very different degrees of sensitiveness to corrosion, lead being the most susceptible, wrought iron much less, while cast iron, particularly the hard white varieties, is frequently if not always immune.

Eighth, though the electric railways have been widespread operation for more than a decade, the gross injury so far discoverable, is of relatively small amount, and has been chiefly limited to the corrosion of a number of telephone cables, the perforation of lead service pipes, and small gas and water mains. A few isolated cases of injury to large mains, and the fall of a stand pipe at Peoria, Illinois, attributed entirely to electrolysis, are the only instances of capital injury on record, but the expert testimony in a suit brought to recover damages from the electric railway company of Peoria, leaves room for reasonable doubt as to whether the railway current was *solely* responsible for the collapse of the pipe, though undoubtedly it played a part therein.

Ninth, usually street railway companies have shown themselves keenly alive to the consequences of electrolysis and anxious to cooperate to any reasonable degree to secure the protection of underground structures.

So long as electric railways employ an uninsulated return, there will always exist the possibility of injurious action to underground metallic structures. As the lead sheath of telephone cables is particularly sensitive, and as even a minute perforation of the lead will destroy an entire section of cable, by the admission of moisture a frequent and thorough inspection of the underground plant is essential. This examination is usually accomplished by testing each cable in each manhole to see whether it is negative or positive to the surrounding earth, that is to say, whether the current is flowing *from* the earth *into* the cable, or from the *cable* into the ***earth,*** and, the ease, rapidity and cheapness with which this examination can be made, warrants frequent repetition. A single inspector, provided with a helper to lift manhole covers, is all the force needed to examine many miles of cable per day. The inspector must be provided with a low reading voltmeter, reading in both directions from zero in the center of the scale. An instrument with a scale of about 10 volts on either side of the center, and capable of being read to 1-100 of a volt, is best suited to the purpose. From the positive terminal a flexible conductor made of good rubber-covered lamp cord, is extended to a pair of hand gas tongs, the jaws of which have been filed smooth. From the other terminal a similar flexible cord is carried to a light, sharp-pointed iron rod, three or four feet in length. The sheath of each cable to be tested should be thoroughly cleansed with a few strokes of emery paper, and then grasped with the gas tongs, thus insuring good contact of the positive wire. There is likely to be more difficulty with the negative pole in securing a good ground. If the vault has a sewer connection, the trap will usually be found full of water, and a good earth may be obtained by dropping the iron rod into it. In other cases, it may be necessary to get an earth by driving the rod between the paving stones into the ground, deep enough to reach moisture. It is inexpedient to ground on a neighboring water or gas pipe, as these structures are quite likely to be at a different potential from the earth, and so give readings leading to incorrect conclusions. When a proper earth is obtained, the voltmeter is observed, a deflection to the right, indicating that the cable is positive to earth, and one to the left that it is negative. Careful notes of the date, time of day, and designation and location of all the cables tested, should be made, as the electrical history acquired from repeated inspections, becomes of great value.

Telephone companies have at their disposal, in the wire network, ramifying throughout the entire territory served, peculiar facilities for ascertaining the electrical conditions of the earth. If each subscriber's line be grounded at the substation, and at the office, it is easy to measure the potential difference. This process is exactly analogous to that of the topographical engineer who, after running a series of levels over a country, can plot a map showing by contour lines the relative hills and valleys of the territory surveyed. Elec-

FIG. 29.—CABLE-SUPPORTING RACKS.

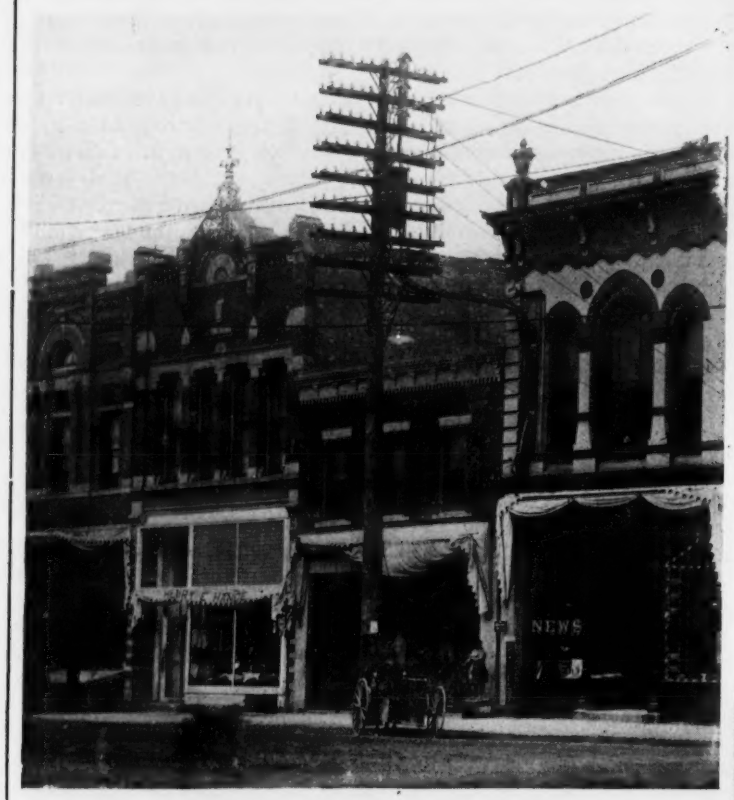


FIG. 30.—ONE METHOD OF LEADING CABLES INTO OFFICE.

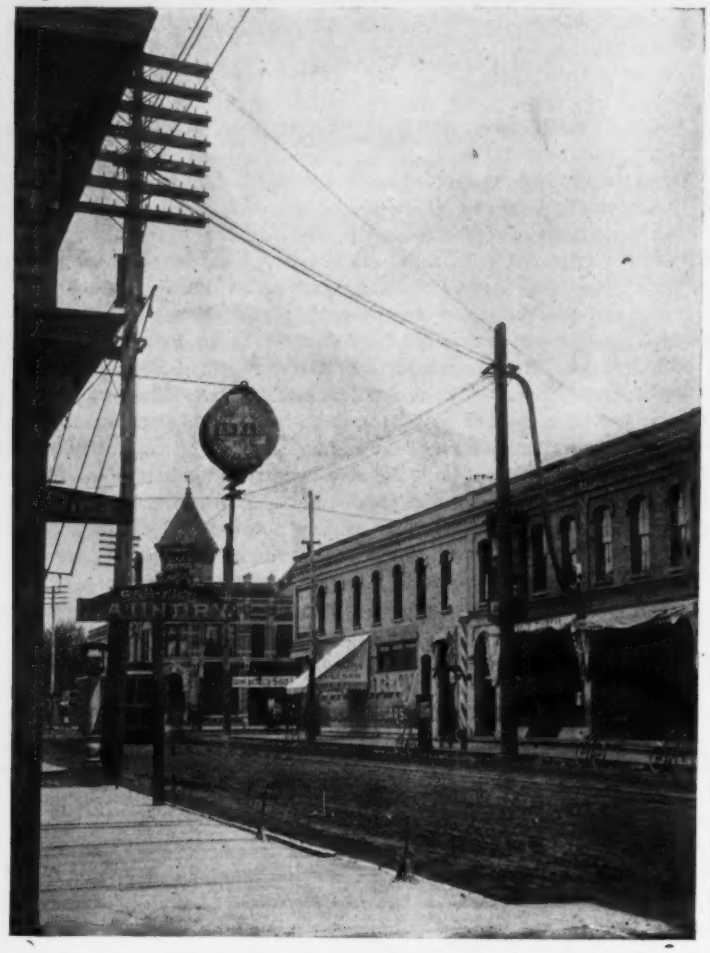


FIG. 31.—ANOTHER METHOD OF LEADING CABLES INTO OFFICE.

INSTALLATION OF TELEPHONE CABLES.

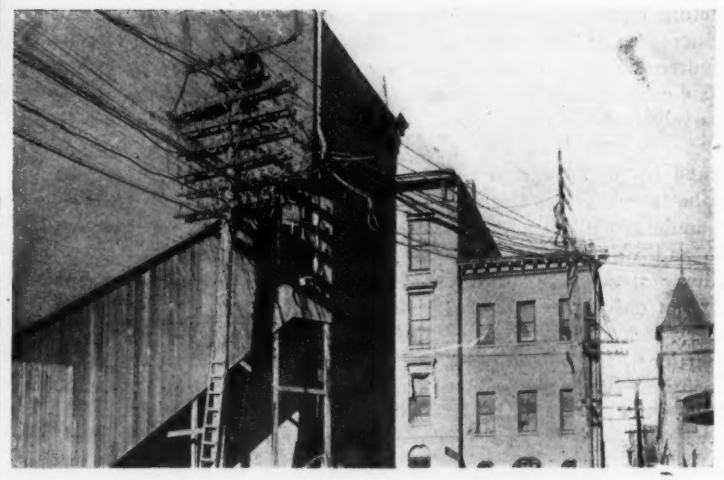


FIG. 32.—WHERE "BUGS" BREED.

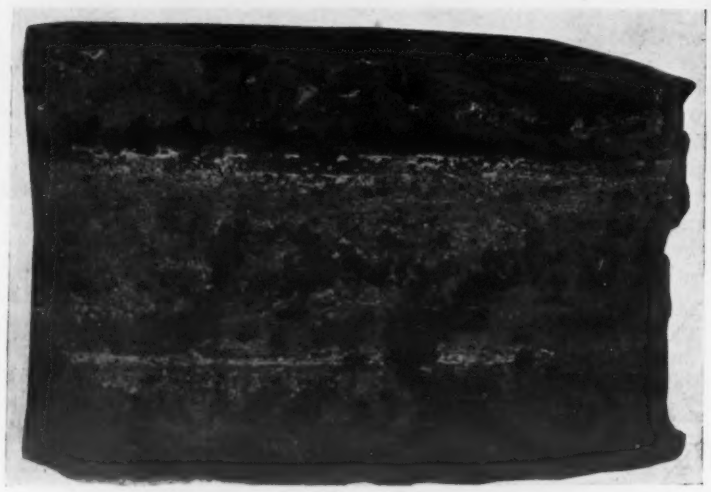


FIG. 34.—CORROSION OF WATER PIPE BY ELECTROLYSIS.

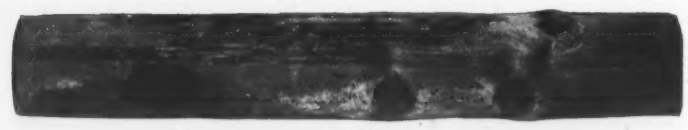


FIG. 33.—CORROSION OF LEAD CABLE-SHEATHING BY ELECTROLYSIS.

trical leveling is even more simple and quickly performed. To continue the analogy, the electrical leveler stations himself in the central office, and is provided with a voltmeter, one terminal of which is connected to a ground wire, while the other is supplied with a single cord and plug, fitting the jacks of the switchboard. The rod man proceeds to one substation after another, and from each calls up the office notifying the leveler to take a reading, at the same time grounding the subscriber's line. The leveler plugs the voltmeter into the subscribers' jack and reads, instantly obtaining the potential difference, or variation in electrical level between the office and the subscriber's station. In such a survey, the time consumed is chiefly that required by the rod man in going from one substation to another, for less than a minute at each is sufficient to call the office and secure a reading, so by having several rod men hundreds of stations may be tested per day with the utmost facility. As the locations of the substations are known, it is easy to plot on a good map the observed potential differences, and then lines drawn through all those of equal value from equipotential curves or electrical contours. Such an investigation may be termed an Electrolytic Survey. Fig. 35 shows the results of such an examination made by the writer in the city of Toledo, O. The contour lines are drawn at intervals of one volt, and show in the most salient manner the distribution of earth potential, and the gradual rise that takes place radially away from the power station of the electric railways. But these curves can teach a still more important lesson. As they are lines of equal potential, it is evident that any metallic conductor so located as to be essentially parallel to any equipotential curve will lie in a region where there is no electromotive force to cause a flow

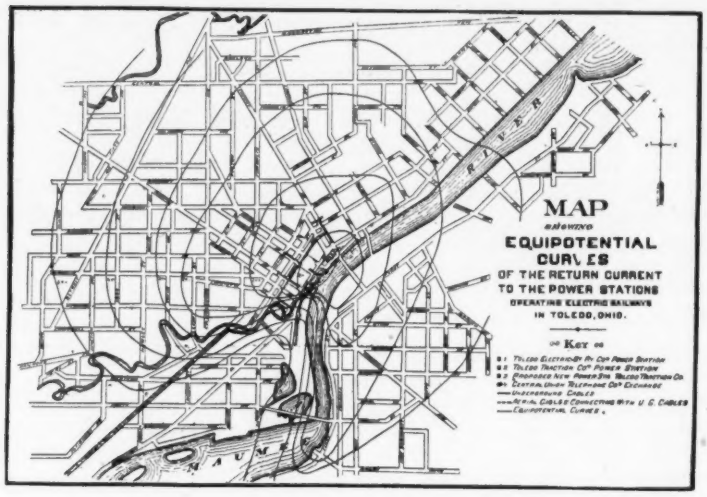


FIG. 35.—ELECTROLYTIC SURVEY OF TOLEDO.

of current, and consequently will not be subjected to any electrolytic action. On the contrary, if a conductor be so placed as cut the equipotential lines, current will flow from the regions of higher potential, to those of lower potential, and corrosive action may be expected, the amount of which may be roughly estimated by the number of equipotential lines cut or the steepness of the electrical gradient. To return to the analogy of the topographical map, if a stream were seen to cut a number of contour lines it could be confidentially predicted to be swift, rapid and full of falls, while if parallel to them, slow and sluggish. Though the electrical survey does not entirely take the place of manhole inspection, it presents a view so much wider, more comprehensive and prophetic that it is well worth its small cost. Nor is it sufficient to make a single examination and rest secure in the assumption that the electric potential is forever settled. Figs. 36 and 37 give the results of two electrolytic surveys made of the city of Chicago, one year apart, showing the very marked change in electrical conditions that took place during that interval. To be sure, the period embraced was one of very rapid railway development, so usually the change would be much less marked, but there is always growth of some kind, either new lines are built or old ones extended, or their loading increased; so that here, as in most other instances, eternal vigilance is the price of security, and a careful examination at least once a year should be made.

Having from the electrolytic survey and manhole inspection determined the various situations on the cable system that are in danger, or where there is a tendency for current to leave the cable sheath for the earth, the next step is a selection of a method of protection. *The current must not leave the cable sheath and pass into the earth.* This is the *only* requisite, and any device accomplishing this result will suffice. It is possible to attack the problem from either end; to prevent current from entering and passing along the cable, or to provide a good way for it to leave the sheath. The first method can be put in practice by insulating portions of the sheath that cut the higher equipotential curves, or those which are more remote from the railway power station. In many cases the simple expedient of cleaning out the manholes and ducts, lifting the cables off the wet floors of the vaults, and supporting them upon insulated pins, driven into the vault walls, will change many electric positive spots to electro negative ones and obviate further injury. Sometimes one or two breaks in the continuity of a long cable will prevent the current from following the sheath. Such breaks may be inserted without risk to the insulation of the cable,

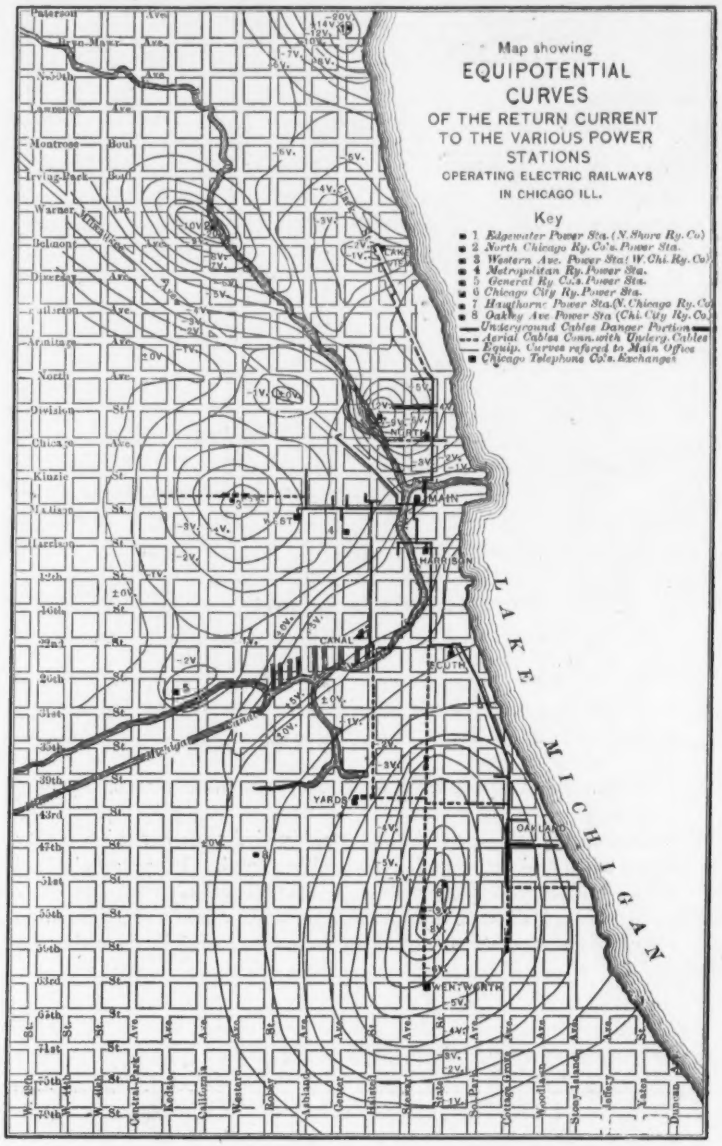


FIG. 36.—ELECTROLYTIC SURVEY OF CHICAGO.

by making "insulating joints" similar to the one illustrated in Fig. 38. This expedient is of special utility, when cables are partly aerial and partly underground.

The second plan consists in providing each danger spot with a supplementary conductor attached to the cable sheath of better conductivity than the earth. This is the *"supplementary return feed"* plan and is usually accomplished by attaching a copper wire of sufficient section to the cable and carrying the same to the railway track if well bonded, or to a railway return feed, or even in extreme cases, clear to the power station itself, and attaching it to the negative busbar of the switchboard. Such cases, however, in the present state of railway construction are rare.

If the current traversing the cable sheath is not large, and the length of the return feeds likely to be considerable, a good ground plate will afford protection. For this purpose a hole four or five

feet square should be excavated deep enough to reach a permanently moist stratum of earth. At the bottom a few bushels of coke will form, a good medium for delivering current to the earth, in which may be imbedded a lot of old rails, discarded car wheels, or any

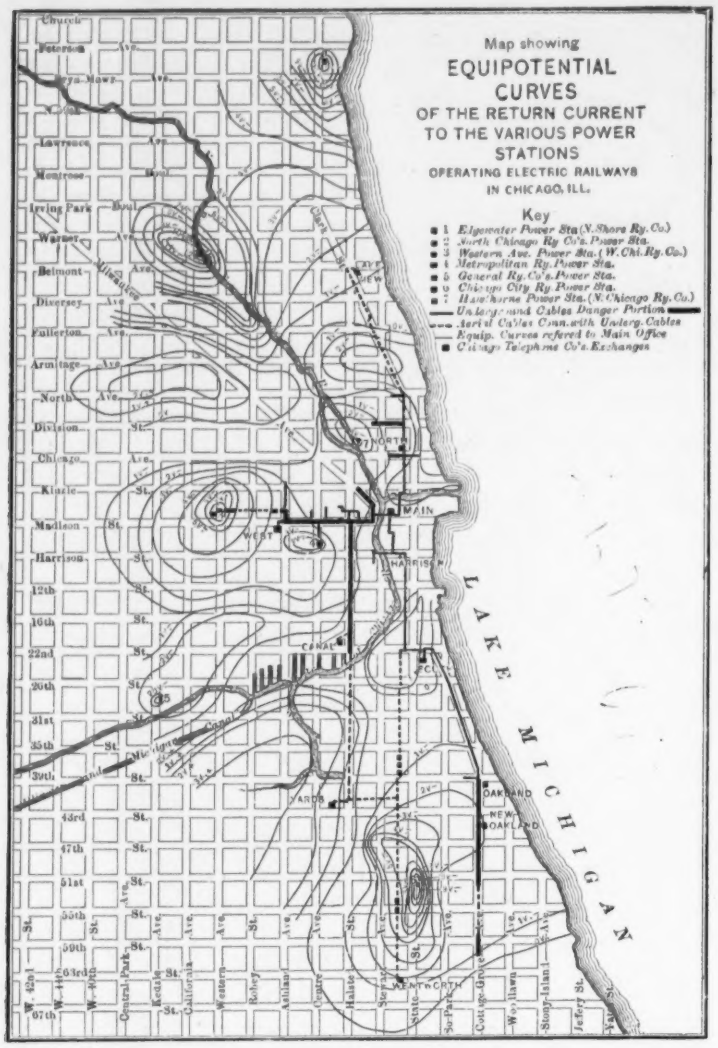

Map showing
EQUIPOTENTIAL CURVES
OF THE RETURN CURRENT
TO THE VARIOUS POWER
STATIONS
OPERATING ELECTRIC RAILWAYS
IN CHICAGO, ILL.
Key
1 Elgewater Power Sta (N. Shore Ry. Co.)
2 North Chicago Ry Co's. Power Sta.
3 Western Ave. Power Sta. (W. Chi. Ry. Co.)
4 Metropolitan Ry. Power Sta.
5 General Ry. Co's. Power Sta.
6 Chicago City Ry. Power Sta.
7 Hawthorne Power Sta. (N. Chicago Ry. Co.)
Underground Cables Danger Portion
Aerial Cables Conn. with Underg. Cables
Equip. Curves refered to Main Office
Chicago Telephone Co's. Exchanges
LAKE MICHIGAN

FIG. 37.—A LATER ELECTROLYTIC SURVEY OF CHICAGO.

metallic scrap. This should be thoroughly tied together with plenty of copper wire, and connected to the cable sheath with an ample lead of copper. The ground plate acts to carry current from the cable to the earth, and diverts the electrolytic action from the sheath to the plate. That corrosion will there take place and in time destroy the ground plate, is unquestioned, but at reasonable expense, the

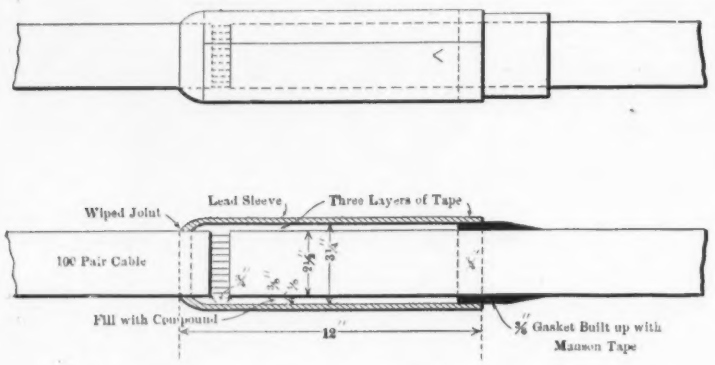


FIG. 38.—INSULATED BREAK FOR SHEATH OF LEAD-COVERED CABLES.

volume of the ground plate can be made so large as to last for many years.

A practical illustration of what the return feed expedient can accomplish may not be amiss. Turning to Fig. 37 a black line will be found extending on Halsted Street from Madison Avenue to Twenty-second Street. This represents a cable run which intersected a number of equipotential curves. Measurements in the various manholes, indicated the potential differences between the cable sheath and the earth, which when plotted yielded a curve something as shown in Fig. 39 at "A." By connecting the railway track to the sheath at

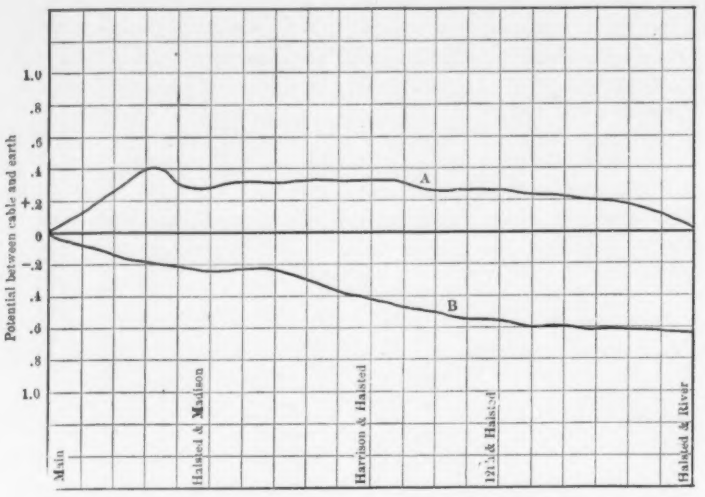


FIG. 39.—CURVES SHOWING POTENTIAL DIFFERENCES BETWEEN CABLE SHEATH AND EARTH.

several points, the electrical conditions were entirely changed to that shown by the line marked "B," indicating complete protection from electrolytic action.

More Tunnel Trolleys for New York.

It is announced that the New York and Jersey Railroad Company's tunnel, for which a franchise was granted by the New York Board of Aldermen last week, is to be used by the Erie and the Delaware and Lackawanna railroads to secure a direct connection with Manhattan by means of trolley or third-rail cars. The New York and Jersey Railroad Company was incorporated under the laws of the State of New York for the purpose of owning and operating the tunnel and railroad formerly owned by the Hudson Tunnel Company, and of constructing and operating a tunnel railroad in the city of New York to be connected with railroads in the State of New Jersey. The Hudson Tunnel Company was organized for the purpose of constructing a tubular tunnel under the North River to accommodate electric cars. After the company had expended $4,000,000 in construction work its workmen struck a rock about two-thirds of the way across the river on the New York side. It was deemed necessary to tunnel this rock. This work the old company never undertook, and the project passed from the public attention for the time being.

The New York and Jersey Company now proposes to complete the project. It is estimated that it will take $6,000,000 more to finish the tunnel and provide the proper terminals. The tunnel will enter New York at Morton Street and will run up Morton to Greenwich, thence along Greenwich to the block bounded by Christopher, West Tenth, Greenwich, and Hudson streets, where the terminal for Manhattan is to be located. The terminals for New Jersey probably will be at the Erie and Delaware and Lackawanna stations.

The Rapid Transit Board considered the proposed franchise on July 10, and by a concurrent vote of six of its members determined the locations and plan of construction of the railway, and also the terms of the franchise. It was decided that the company should pay the city a rental, which should be readjusted every twenty-five years. Under the terms of the franchise, the city is to receive 3 per cent. of the gross receipts of the company on that portion of the railway lines in New York for the first five years and 5 per cent. thereafter. Some regard these terms as even better than those arranged with the Pennsylvania Company. W. G. McAdoo, the president of the New York and Jersey Railroad Company, was assistant secretary of the Navy under President Cleveland.

Economic Operation of Electric Irrigation Pumps.

BY AUG. J. BOWIE, JR.

THE manner in which electric irrigation pumps should be installed and operated varies largely with the conditions of the case. The general considerations governing the installation of the same have been reviewed in an article by the writer, printed in the issue of the ELECTRICAL WORLD AND ENGINEER of August 9, 1902. The economy in the operation of these stations plays a very important part in the price of the water pumped. Poor management in this direction may fully double the amount which the water should cost. The location of the pump stations is important. As a rule, it will not pay to pipe the water or to convey it in any other channels but canals made in the ground, except for short distances. A canal is usually the cheapest conduit for the water which can be built, and will answer in most cases. This is a matter which may influence the location of the station to a great extent, as the canal must be at a sufficient elevation to be able to wet all the ground to be irrigated.

Where possible, it is well to have the stations located in such a manner as to be able to use the combined flow of several, in case a larger head of water should be desirable. Perhaps the most important point, however, is that the stations should be so located that they will be able to run continuously, night and day, for the whole year, and so obtain all the available water from each one. In that way the fixed expenses per cubic foot pumped may be greatly reduced. There is no reason why the station need be shut down at night, and thus the work of irrigation may go on continuously.

The stations should be so placed that the distance which the water must travel will be as short as possible. The main object of this is to minimize seepage and evaporation. Another reason, however, is that the ditches themselves hold considerable water and may have to be filled well up in order to raise the level of the water sufficiently to reach some of the land. Most of this water will be lost, and it may in some cases take several hours pumping to fill the ditches to a sufficient level to render the water available for irrigation. For this reason the ditches themselves should be as small as possible. However, on the other hand, there will be practically a limit to the size of the ditch, depending on the manner in which it is made. For example, if scrapers are used in building the ditch it will probably not pay to make the ditch so small that a scraper cannot work to advantage in it.

In the economic operation of irrigation pumping stations it is very important to reduce to as small a point as possible the loss by seepage. In some countries this loss may be so great that special means must be taken to obviate it, as the irrigation system may be a financial failure unless due precautions are observed. Among other means of avoiding undue seepage, some of the following methods may be employed:

1. Cementing ditches with a thin layer of cement. 2. Puddling the ditch. 3. Open iron conduits. 4. Iron pipes. 5. Wooden flumes.

While wooden flumes may be comparatively cheap to install, they are not naturally suited for use in this kind of irrigation, for the reason that in the natural course of events they will be constantly getting wet and then drying, with the result that they will soon rot and leak.

The conditions of the problem should be carefully studied before laying out any system of irrigation. The size of the checks (if that method of irrigation is to be employed) should be given due consideration. Some land it will not pay to irrigate simply on account of the great loss by seepage, not alone in the ditches, but also in flooding the checks. In fact, much land it will pay much better to abandon entirely than to try to irrigate it at a great expense.

The amount of water used in irrigation depends largely on the nature of the soil, the method of irrigation, the previous condition of the ground as regards moisture, as well as on the crop growing on the land. If the soil is very sandy and porous it will take a great deal of water. If there is a clayey subsoil near the surface this will cut down very materially the water required. Small checks take considerably less water per acre than large ones when irrigating with a given head of water. They require more attention, however, and they interfere with agricultural operations.

In irrigating for alfalfa, it is necessary to flood the entire ground with water. The amount of water required for an irrigation for the same will vary from about six inches to two feet. That is to say, in order to irrigate the land properly it will take a quantity of water sufficient to cover the ground to be irrigated to a depth of from six inches to two feet for each irrigation. The latter figure would be high; in general too high to pay for irrigation by pumps. Some land will take even more than this quantity, but such land it will pay to leave alone. Fruit trees are usually irrigated by running the water in furrows across the land, and hence it is unnecessary to wet the entire ground, thus resulting in a considerable saving in water.

The number of times it is advisable to irrigate per year depends on the rainfall and the climate. Thus, for example, where the rainfall is small, as it is in the southern part of California, it is customary to irrigate for alfalfa about four times a year.

Water for irrigation is commonly reckoned in acre-feet, an acre-foot being the quantity of water which will cover an acre a foot deep. A flow of a second-foot, that is, one cubic foot per second, will cover two acres one foot deep in a day of 24 hours. One second-foot rate of flow will cover 730 acres one foot deep in a year. That is to say, it will irrigate 182 acres of ground four times a year, provided each irrigation requires one acre-foot per acre. At this rate it will take a flow of 3½ cubic feet per second to irrigate a section. Owing to the loss in the ditches and canals and to the interruptions in the service, this figure will generally be materially increased in practice, particularly in the case where the water is pumped, and consequently only a comparatively small head used. One unit of the rate of flow of water, which is also in use in some parts of the country, is the miners' inch. This is a variable quantity having different values in different parts of the country. As commonly used in irrigation, a miners' inch, or an *inch*, as it is usually called, means a rate of flow of 1/50 second-foot. In irrigation stations of any capacity this unit is usually too small to be convenient, but in some parts of the country where water is very scarce and is almost worth its weight in gold, the inch becomes a unit of mammoth proportions. In a certain law suit in the southern part of California, one of the witnesses who was testifying in the case was asked the question of how much water was flowing in a certain place. He replied that there was a very large flow. When asked to be more specific and to state how large the flow was he replied that it was almost as much as two inches!

The question of attendance in the operation of pumping stations cuts a very important figure in the cost of the water delivered. Perhaps there is no subject in this connection on which there is a wider difference of opinion than on the amount of attention it is necessary to give to the operation of the pumps. For instance, some people who run pumps continuously, day and night, have as many as three different pump attendants for one 30-hp motor and pump, each man taking an eight-hour shift. The writer, on the other hand believes in the other extreme; that is to say, having one man look out for several pumps, visiting each pump in operation about twice a day. Provided there is a competent foreman there is no necessity for a pumpman to be a skilled mechanic, and any man of ordinary intelligence can give good service with comparatively little instruction. However, it is essential that the installation be made in as thorough a manner as possible, and that the station be kept in first-class running order. Simple automatic cut-outs should be provided to switch out the motor in case the current goes off for more than a few seconds, or in case the pump loses its priming. These should be made as reliable as possible. With proper care and attention to details, there is little likelihood that any serious accident will occur, the worst thing liable to happen being burning out a bearing or blowing a fuse. It is certainly cheaper to have a few such accidents happen than to pay for constant attention otherwise not needed.

The oiling devices should be as good as possible, self-oiling bearings being used where possible, so that in event of the attendant being unable to get to the station there will be no danger of the bearing going dry. On this account oil cups where they are used should be of ample capacity. The bearings should be dustproof, otherwise trouble is apt to ensue.

While skilled labor is not needed for the operation of stations, it is by all means essential that the foreman should be a thorough mechanic. On him will depend much of the successful operation of the plant.

The Kern County Land Company, with which the writer was connected, had 27 pumping stations for irrigation purposes. At each station there were two transformers, a 30 or 40 hp motor and a suitable centrifugal pump. Three pump attendants looked out for the operation of the stations. They were expected to visit each station in operation twice a day. To do so they had to drive from 20 to 30 miles a day. In a year's operation of these stations there were perhaps a dozen bearings burnt out, and in one or two instances the shafts had been cut at the bearings and had to be turned down. The total

cost of all such accidents would not have been sufficient to have paid an extra pumpman for even three months.

At each station some simple means of measuring the water should be provided. The pump attendant should keep a daily record of the output of the station. Perhaps the simplest means of measuring water in such cases is by means of a weir. This, it is true, adds somewhat to the head which it is necessary to pump; still, the extra head may be made very small, and it is usually preferable to have the discharge above high-water mark in the ditch so that the water in the ditch cannot back up into the station. The writer adopted the following method of keeping account of the stations. A fixed size weir was put in at each station. The crest of the weir was made of a strip of galvanized iron nailed to the wooden flume. The flume was long and large enough to reduce the effect of unequal velocity and velocity of approach very largely. A nipple passed through a hole in the side of the flume near the crest. A glass tube was set into an ell on the outside of the nipple and served to measure the head on the weir. A horizontal strip of wood was nailed on the side of the box at the level of the crest of the weir, so that a single measurement with a rule gave the depth of water over the crest of the weir. A suitable logbook was provided for each station. A table was printed in the back of the book giving the discharge in cubic feet per second for different heads. The pumpman thus had no calculations to perform and but a single measurement to make. No measurements of the flow of water were to be taken unless the pump had been in operation for at least a half-hour previously, as, of course, at first the flow is much increased, especially where the pit had filled up with water. Twice a month pressure and vacuum readings were taken on the pump, and also readings of the level of the ground water when the pump had been shut down for some time.

At first sight it might seem superfluous to make much of a point of taking these readings. But, as a matter of fact, the information so derived is decidedly conducive to operating under better efficiency. The discharge from a centrifugal pump will vary from many different reasons. Wear in the running rings will increase the back slippage of water and decrease the output. A small leak in the suction side of the pipe or pump or in the stuffing box may admit sufficient air to affect materially the output. The discharge also depends on the level of the water in the wells and also on the amount of entrained air in the same. Sanding up of the wells will, of course, tend to throttle the water flowing into them.

By keeping an accurate record as above described, a very good idea may be obtained of the probable trouble causing a falling off in the supply of water. Besides, all such information is important for statistical purposes.

Where stations are to run with no one in constant attendance, it is especially advisable to keep them in the best of repair. It is by such means that accidents are avoided and the plant is kept up to its proper efficiency. With high-speed machinery this is particularly essential.

As to the best speed of centrifugal pumps, there is quite a difference of opinion. There had been in the past a tendency toward slow-speed pumps, and a decided feeling against running them at higher speeds. In electrically driven irrigation plants, induction motors are in common use, 30 to 40-hp motors being commonly employed for such purposes. These motors are 4-pole, 60-cycle machines, and consequently run at 900 revolutions per minute. At first the motors were belted to the pumps, the latter running about 400 revolutions per minute. Now direct-connected units are coming into general use.

The principal objections which can be urged against high-speed pumps are the vibration, if not properly balanced, and the more rapid wear of the running joints of the pump. One trouble with many of the pumps is that the shafts are too small. With larger, stiffer shafts and more careful balance the vibration can be largely avoided, and the wear of the running joints also greatly reduced.

The advantages of high-speed are twofold. In the first place, the pump is reduced in size and is made both lighter and cheaper; and in the second place, the efficiency is improved, due to decreasing the friction on the sides of the runner. The power consumed in a surface of area, A, passing through the water with a velocity V feet per second is equal to AV^3f foot-pounds per second, f being the coefficient of friction. In the case of a pump runner, the expression given above would have to be integrated over the surface of the disc. It is thus apparent that when the speed of the runner is increased, while the peripheral velocity remains the same, the diameter of the runner must be decreased, which will, of course, decrease the friction at the same time, and hence make the pump more efficient. The smaller the capacity of the pump, the larger will be the relative percentage of friction loss to output; hence the greater the gain by increasing the revolutions per minute. Thus, within reasonable limits increase of speed of the pump is desirable and tends to render the pump more efficient, provided it is properly designed.

Of course, increase of speed does demand more careful balance of the running parts, and involves somewhat more wear and tear. The advantages, however, will in general outweigh the disadvantages. The most suitable speed for a centrifugal pump is not necessarily the most efficient one, and it will depend on the capacity of the pump and the lift. For example, a pump of large capacity and consequently large suction inlet, would require a lower speed and a larger diameter runner than a pump of smaller capacity, when operated under the same head. On the other hand, if two pumps were to deliver the same quantity of water at widely different heads, the pump with the higher head should be of larger diameter and of higher speed than the other pump, as it would probably be desirable to increase the diameter of the runner somewhat, in order to keep the speed within practical limits.

The idea is quite prevalent that the field for centrifugal pumps is limited to very low heads, and that for heads of moderate height they are hopelessly inefficient. This idea is due in part to tables published in engineering handbooks, which give a very erroneous statement of the true facts of the case. They largely exaggerate the facts, except as regards very small pumps. This will be apparent by considering the effect of running a given pump at different speeds.

Suppose at R revolutions per minute, the pump is designed to give a flow of Q cubic feet per minute under a pressure of P pounds per square inch. Let W be the horse-power required to drive the pump at this output. Suppose the speed of the pump is increased to R_1 revolutions per minute, let $\frac{R_1}{R} = K$. Then the capacity of the pump will be $K\,Q$ cubic feet per second, the pressure generated will be $K^2\,P$ pounds per square inch, and the horse-power required to drive the pump will be $K^3\,W$. The efficiency will be the same in the two cases, since all the energy losses will be multiplied by K^3. The relative angles of entrance and departure from the pump disc will also be just the same in the two cases. This, of course, means that to design a pump to deliver the same quantity of water at a higher head a smaller size pump, and hence one not so efficient must be used to attain a maximum efficiency. This would mean that very small pumps are very inefficient under high heads. But still, even for low heads such pumps would be inefficient, due to the large friction on the runner. Higher heads require stiffer casings and more wear on the running rings of the pump. However, simple means may be adopted to obviate in great part the effect of the latter.

Many pump manufacturers rate their pumps as having a certain capacity without stating the head against which the pump is to work. They sometimes furnish a table showing the speeds required for different size runners to give various heads, but do not specify the head under which the pump should deliver its rated capacity. Such rating is obviously wrong, as the capacity of the pump under conditions of maximum efficiency should vary directly as the speed of the runner, and is by no means constant.

The simplicity and cheapness of centrifugal pumps, as well as the fact that they can be direct connected to motors with excellent results, are what commend them particularly for use with electric power, even at somewhat lower efficiency than could be obtained from reciprocating pumps.

The actual cost of pumping water for irrigation will, of course, vary largely with the conditions of the case. The distance to ground water, the available capacity of the wells, the distance between stations, the number of stations operated as well as the percentage of time during which they are in operation, the facilities for making repairs, and last, though not least, the price of power, will all affect materially the cost of pumping water.

As a basis for comparison, certain assumptions will be made. Suppose the distance from the surface of the ground to ground water is ten feet and that in pumping the water is lowered 22 feet further in the wells. Allowing four feet additional for friction as well as for extra elevation of the water to get it into the ditches, gives an effective head of 36 feet. Assume the efficiency of the pump to be 50 per cent. Considerably higher efficiency than this should be attained when the pump is new and is pumping under favorable conditions. However, the wear in the pumps, the varying head, due to variations

in level of the ground water, and the entrained air in the same will cut down the efficiency of the pump, and 50 per cent. will be a fair figure in practice.

Assume that the pump will deliver a flow of 5 second-feet. This will call for a 40-hp motor. Suppose power distributed to the pump stations at high pressure, say 10,000 volts. Such a station should be installed complete for about $4,000, provided wells of moderate depth will furnish the desired water. If a number of stations are to be put in, they could be installed at a lower figure. Suppose one pump attendant is able to look out for six such stations. The annual expense of operation would be as follows:

Interest and taxes, 7 per cent. on $4,000	$280
Depreciation, repairs and renewals (10 per cent. on $4,000)	400
Attendance	180
Total	$860
Cost per station per day	$2.36
Cost per cubic foot per second per day	.47

The attendance includes the cost of horses for the pump man.

Assuming the cost of power to be $50 per horse-power year gives the annual cost of power $2,000 per pump station; cost of power per second-foot per day, $1.10; total cost per second-foot per day, $1.57.

Assuming that the pumps run only half the time, and that power is paid for at the above rate, but that charge is made only for the actual time the pumps are in service, we have:

Fixed and operating expenses per second-foot per day	$.94
Power per second-foot per day	1.10
Cost per second-foot per day	$2.04

The above figures refer to a 24-hour day.

Assuming power to cost from $50 to $100 per horse-power year, only that which is actually consumed being paid for at that rate; also assuming that the stations are run from 12 to 24 hours per day, the cost per second-foot per 24-hour day will lie between $1.57 and $3.14.

Assuming that one second-foot will irrigate two acres in a day, and that the land requires four irrigations annually, one pump station will irrigate 910 acres per year, and the cost per acre will be from $3.14 to $6.28 per year. Assuming that the crop is alfalfa and that the ground will grow a ton to the acre for each irrigation, the land will produce 4 tons of hay a year at a cost of from 79 cents to $1.57 per ton for the water. Individual plants will, of course, cost more to run for many reasons, but under the conditions assumed, and with cheap power and fair land the cost of water should not exceed $1.25 per ton of hay. Some land will produce as much as two tons to the acre for each irrigation.

So many conditions enter into the problem that it is simply impossible to make a statement of cost which will apply in general. The water supply, the depth from which it must be pumped, the nature of the soil, and the cost of power are the principal elements which affect the cost of pumping, and these are widely divergent in different cases. The seepage in the canals will often interfere seriously with the work which a station should accomplish, and will necessarily limit its field of operation.

The actual cost of pumping water for irrigation by the Kern County Land Company came well within the limits given above.

Western Union's Railway Circuits.

At Newark, N. J., on December 18, Judge Fitzpatrick, in the United States District Court heard argument on the rule to show cause why an injunction should not issue to restrain the Pennsylvania Railroad Company from removing or interfering with the Western Union Telegraph Company's wires along its system. By agreement similar proceedings in the United States Courts of Pennsylvania had been held up to suit the convenience of the lawyers who preferred to have the first test made in New Jersey. The telegraph company was represented by John F. Dillon, Henry D. Estabrook, and Rush Taggart, of New York, general counsel for the Western Union, and R. V. Lindabury, of this city. In behalf of the railroad company appeared James B. Vredenburgh and R. L. Lawrence, of Jersey City, and ex-Judge John G. Johnson, of Philadelphia.

Mr. Lindabury, after describing the contracts between the companies, said that the Western Union was negotiating for a new contract when, on May 14, it received notice from the Pennsylvania Company that the contract of 1881 would not be renewed, and that the company must vacate within six months from June 1 following. Subsequently, he said, the Pennsylvania Company accepted and receipted for rent for May and June, despite the fact that under the contract no rent was to be paid after six months' notice had been given. The acknowledgment of the rent, he said, voided the notice under the common custom of landlord and tenant, and the Western Union stood without any notice to vacate. But aside from that, he said, the Western Union was a Government agent, and could not be removed from the position it holds. It could only be made to pay a reasonable remuneration. He claimed that under an amendment to an act of Congress in 1866 all railroads are post roads, and therefore the Western Union had the right to occupy the right of way along them by paying a proper rental.

The Armature Reaction of Alternators—VIII.

BY C. F. GUILBERT.

THE construction described in the previous article is that which the author used before knowing the one indicated by Picou, which we shall use again further on. We will now take up the construction of the diagram for load conditions and a given phase angle, ψ.

After having determined the part of the flux which the field should actually furnish, or the corresponding e.m.f., $O\ A$ (Fig. 10), and bearing in mind the view adopted, it suffices to drop on $O\ A$ a perpendicular $A\ B$ of a length equal to transverse flux calculated, as has been indicated, or to the corresponding e.m.f. Next is drawn a perpendicular to the direction of the current flow, a vector, $B\ C$, representing the e.m.f. of dispersion; then parallel to the direction of the current a vector, $C\ D$, equal to the ohmic drop, increasing it as is usual by the apparent augmentation of the resistance to take account of Foucault currents. The vector, $O\ D$, will then represent the value of the binding-post voltage and the phase. The necessary excitation is determined by summing the different m.m.fs which are required in the field to give finally a useful flux, $O\ A$, in the armature.

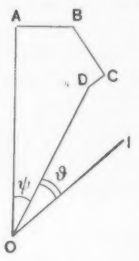


FIG. 10.

The only quantity remaining is e.m.f. of armature dispersion, and the calculation of these involves difficulties in arriving at a sufficiently exact result. This e.m.f. naturally depends on the form of slot teeth, their number per phase and pole, the exterior leakage and the total armature m.m.f. The armature e.m.f. can be separated into two distinct parts, one due to the actual self-induction of the armature winding and corresponding to the major part of the portions of the winding exterior to the armature; the other corresponds to a fictive self-induction, due in reality to a decrease of the useful flux caused by the crowing toward the gap of the lines of force entering the teeth. By this is understood that the lines of force entering the teeth and constituting the part of armature dispersion flux under consideration come from the field and thus correspond to a real augmentation of the field dispersion aside from that already noted above, and which occurs in the gap and between the pole horns and core. In other words, this part of the armature dispersion, though in phase with the armature current, is in fact really to be credited to the field.

As a first approximation, it can be admitted that the dispersion e.m.f. is from 10 to 15 per cent. of the normal terminal e.m.f., according to the number of ampere-turns per centimetre of the developed armature per phase. This can be determined experimentally, for a given type, by unwinding, turn by turn, a test coil, and observing the voltage induced in the coil for the case of short-circuit, for example. On short circuit, in fact, the only flux passing through the armature corresponds solely to dispersion e.m.f. and ohmic resistance.

DIAGRAMS OF THE SECOND AND THIRD CLASSES.

The diagrams already given answer for the present rigorous technical demands, and will serve for the predetermination of load characteristics of alternators having quite high saturations both in

armature and field, but the method is laborious in application. As many alternators are yet made having an induction in the teeth so small that with a reasonable gap the armature characteristic can be considered practically a straight line, it will not be without interest to give a simpler diagram applicable to such cases. The subject will be broached by a discussion of the diagrams of the second and third. The latter are ordinarily generalizations more or less complete of asynchronous motor diagrams such as that published in 1896 by Blondel. This was generalized by the author in 1897 for the case of a motor armature containing an inductance or capacity, and then applied to the case of alternators.

Whether this application is justified is doubtful, for reasons that follow. The asynchronous motor diagrams depends upon the fact that the resultant flux is produced by resultant m.m.f. of the armature and field. It appears to us that this assumes, which is true of the asynchronous motor, that the armature and field have not salient poles or, in other words, that the armature m.m.f. can, in every position with respect to the field, have effect on a magnetic circuit always identical with itself and comprising the field magnetic circuit. This amounts to saying that the direction of the field flux is not determined by the conditions of the design of the machine since it necessitates no visible separation between the field poles.

For alternators with separate pole, this is no longer true; the direction of the field flux axis is well determined in the core and in the frame, and it is only in the pole pieces, gap and armature that this direction ceases to be fixed. It results that in these parts alone can the composition of the m.m.fs follow the polygon of forces. This is also a consequence of the fact that the transverse and direct reactions are manifested together only in the pole pieces, gap and armature.

The permissible composition is thus only simply that of the difference of inducing magnetic potential between the two faces of the gap on the one hand and that of the difference of potential between the same faces due to the armature m.m.f.

If the armature is only slightly saturated, it is readily seen that we can combine the armature m.m.f. with the ampere-turns necessary for the gap and increased by a certain percentage to take account of the reluctances of the armature and the pole faces, supposed to be constant.

If we can assume that b is equal to a, the construction of the diagram becomes much more simple, for it no longer necessitates knowing the total phase angle, ψ, and consequently permits starting with the terminal voltage in constructing the complete diagram.

Let us assume that the terminal voltage is v, the current I, and that the angle between these is ϕ; we can then construct (Fig. 11) the voltage diagram by adding successively and geometrically to v the ohmic loss, rI, and the e.m.f. of armature dispersion. The resulting e.m.f., $O\ C$, corresponds to the useful flux in the armature, and we then lay down on the armature characteristic the number of ampere-turns necessary to maintain this flux at no-load, and, which should correspond to $O\ C$ by a suitable choice of scale for the ampere-turns. If we then draw from the point C a perpendicular $C\ D$ in the direction of the current and equal to F_i ampere-turns, the right line, $O\ D$, will represent the direction of the m.m.f. or of the field flux. If we decompose the flux, $O\ C$, in the direction of $O\ D$ and its perpendicular,

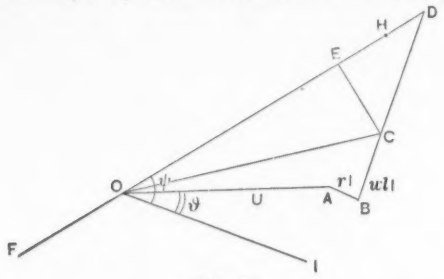


FIG. 11.

we will have in $O\ E$ the flux which, independently of leakage, will traverse the field, while $E\ C$ will be the transverse flux, the fluxes being here proportional to the differences of magnetic potential which produce them.

The vector, $O\ D$, represents the difference of magnetic potential between the pole horns, and it suffices to add thereto the m.m.f. of the direct reaction, $E\ D$, to have the total m.m.f. necessary to cause the useful flux to pass into the armature, and to balance the armature m.m.f. It is, in fact, easy to show, by reference to Fig. 9 (homothetic rectangles $A'\ M\ P\ A$, $A'\ M''\ C\ B$) that when the part $B'\ M$ of the characteristic $O\ M$ is a straight line, the point B' is on the same vertical as B; or in other words, that the m.m.f., $B'\ M''$, necessary to be added to the difference of magnetic potential between the pole horns, to maintain the same flux, $B'\ M''$, at load and no-load, is equal to F_i; the quantity $F\ J$ is then equal to $\frac{r}{R_a} F_i$. The field leakage is of the same phase as the flux in the core, and its value, $E\ H$, practically proportional to $O\ D$, should be added, *not* geometrically to the flux $O\ C$, as has heretofore been done, but to the flux, $O\ E$*. The resultant flux in the field is then $O\ H$. It is not, however,

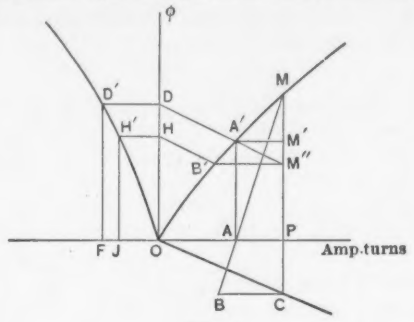


FIG. 9.

necessary to lay down this flux in the diagram, as the partial characteristic of Fig. 9 gives immediately the number of ampere-turns necessary to pass the flux, $M''\ P$ into the armature with the different leakages, including those due to the increase of m.m.f. necessary to compensate for the armature ampere-turns.

As can be seen, this diagram assumes only one thing, namely, that the armature characteristic is practically a straight line; the field can be saturated to any extent without effect on the exactitude of the method.

The considerations that have been set forth in this article are evidently not yet perfect, principally as concerns the manner of obtaining the value of the mean transverse flux, and that taking account of field magnetic leakage. With respect to this latter point of view, we have been obliged to admit that the field leakage are determined by the magnetic potential between the polar projections. In reality, this is only true for the part of the field magnetic leakage between the pole horns; the other part—that between the cores—depends upon a m.m.f. not possible to fix by direct calculations, but which may be approached by successive approximations.

However this may be, we believe that the formulas established and which have been verified with great care on a number of machines, particularly with respect to the predetermination of the short-circuit line, as well as the two diagrams given, may render some service to engineers engaged in the design of alternators. In a following article some numerical applications of the method and formulas will be given.

Statistics of Gas Apparatus and Supplies.

A recent bulletin of the United States Census Office gives the following figures as to gas apparatus in 1900:

Items.	Gas and lamp fixtures.	Gas and oil stoves.	Gas machines and meters.
No. establishments	223	35	114
Capital	$10,009,239	$3,766,065	$4,605,624
Salaried officials	875	191	257
Salaries, total	$992,003	$231,436	$251,382
Wage earners	7,642	2,471	2,167
Men	5,582	2,458	2,003
Women	1,754	8	64
Children	306	5	10
Wages, total	$3,504,301	$1,138,442	$1,185,950
Miscellaneous expenses	1,023,036	274,242	191,058
Cost materials	5,013,597	2,501,568	1,943,769
Value products	12,577,806	4,579,700	4,392,730

The total value of all manufactures as given in this revised and extended report is $13,014,287,498; cost of materials used $7,348,144,755; miscellaneous expenses, $1,028,035,611; salaries, $404,230,274, and wages, $2,328,691,254. This would leave a profit of nearly 20 per cent on the total capital of $9,835,086,909. There are also noted 19 firms making calcium lights; charcoal, 183; coke, 241,; electrical apparatus, 580; electrical construction and repairs, 1,162; fertilizers, 422; graphite refiners and producers, 11; manufactured ice, 775; lamps and reflectors, 156; matches, 22; petroleum refining, 67; plumbers' supplies, 174; plumbing, gas and steam fitting, 11,876.

* M. Bauch, whose diagram resembles the present one in the separation of the armature amnere-turns from those of the field, makes also the same error as those who preceded him.

A Universal Patent Examination System.

A very interesting article on the value of inventions, the growth of the patent system, and the need of improvements in the methods is published in the *Yale Law Journal* for December, from the pen of Mr. John S. Seymour, United States Commissioner of Patents under President Cleveland. One notable point is dwelt upon, namely, the need of preventing so much duplication of work in authenticating the value of a new patent. Mr. Seymour discusses the "examination" system as follows:

Having now shown the beneficient tendency of patents when well grounded in view of all the prior art, and how they may become no better than the odious monopolies of Elizabeth and Charles I and the Bourbon Kings, when granted without anything new, and having shown that to grant patents without examination has resulted in England in the issue of 42 oppressive patents to 58 lawful ones, it amounts to a demonstration that the examination system must be installed wherever the patent system extends, and that in every country, more than eighty in all in the civilized world, where patents are granted, the same material must be collected that we have collected at Washington, that England is about to collect, that Germany and Sweden must provide, and that the equivalent scientific corps of hundreds of examiners must be organized into an effective body in every separate country, to work upon this material, first, to classify it, then to understand it, then to bring it to bear upon new applications as they are presented, thus manifolding scores of times the equipment and the work that is necessary for the grant of a single valid patent.

An American inventor who applies for a patent in England, after having obtained one at home, will have performed for him at the public expense the same search *through the same material* in order to grant an English patent that has already been made for him through the same material in order to apply for his patent here. If he should also apply for a German patent, the same search would be again repeated by the German officials over the same ground, and so it would be for Sweden, and so we may say it ought to be repeated in every other country where patents are granted. There is no escape from this except in co-operation between nations.

Having in our progress conceived the patent system as divested of many of its disfiguring features, we are now prepared to take one further but most important step in the perfection of the system, from which patents in several countries or in all countries may be granted upon one competent, exhaustive and thoroughly reliable search made in the one country where it can be made best, without burdensome expense, without delay or denial of justice.

Slight changes in the patent systems of the world would harmonize them to such a general regime. The innovation would be startling, but it would violate no principle, nor would it be comparable to universal legislation for the world.

To centralize scientific work that is already four times manifolded and is destined to be greatly multiplied is not visionary, because the system ought to exist. There may be no other governmental function open to this treatment, unless observations of the weather may be, and yet other analogies are found. The Postal Union has established joint action in the matter of foreign mail, and seals, the Behring Sea, Samoa, ocean cables, the open door, ships, missions, coaling stations, arbitration of international disputes, have been the subject of world legislation, or treaty.

We have a faint beginning in the International Convention concerning trade marks and industrial properties with its bureau at Berne in Switzerland maintained by many countries, including all the more important ones and our own, but its functions are limited to a few factors in the problem, and its equipment for the work here contemplated is inadequate.

The Hague Peace Tribunal, marking an epoch in civilization, placing Nicholas II of Russia and De Bloch in the foremost rank of philanthropists was the product of intellectual forces making for a rationally organized world. But this tribunal is only occasionally in action to prevent international ruptures and settle disputes after they arise, somewhat as electrical apparatus was, for more than a generation after Franklin, used merely to ward off lightning.

But the universal patent office could not only do quicker and better what the separate patent offices now do, but it would act continuously and affirmatively upon human affairs to give a constant stimulus to genius in every country, to benefit mankind at large by expanding and improving the industrial arts, and to weave thousands of silken threads to bind the nations together in an elevated and rationally guided daily life.

As matters now stand, the inventor of a machine or product or the discoverer of a new process may have a patent in every country of the world having a patent system upon paying the fees, which are in the aggregate burdensome even when but few out of the many are taken. Yet nothing is done to make sure of the validity of the patent except the search on the question of novelty and the decision on the question of invention, neglecting for the moment mere matters of form. One search being as good as eighty, and two searches on the same subject being useless, there must be a practical way in which the United States can share with others the use of its accumulated material. Two countries can act together, either by treaty or by passing the same law providing for joint action.

As the United States has been foremost in establishing the examination system and making use of the means by which valid patents may be granted and invalid patents withheld, it might fitly take the initiative in proposing joint action in the matter of patents, for example, with Canada our neighbor on the north, or with Mexico, or with the South American Republics, or with Spain, or with any country not likely on its own initiative to establish this costly machinery of its own, offering to investigate and pass upon the question of novelty and invention for every applicant whether desiring a patent in the United States alone, or in one or more or all of the foreign countries who should accept this offer of joint action and provide for carrying it out.

The rest would be the machinery for authenticating the patent by the signature of an accredited agent of such foreign country, or its present resident ambassador or minister.

Thus a patent issued by the resident ambassador at Washington countersigned by our Commissioner of Patents might by appropriate legislation be as valid and effectual in Mexico or Canada or Venezuela or Peru, supposing these countries united with us upon this plan, as though the patent were issued upon original proceedings in each of these countries.

Recent Electrochemical Developments.

BY CLINTON PAUL TOWNSEND.

COMBINATION METHODS IN ELECTROMETALLURGY.

Mr. Alfred Dorsemagen, of Wesel, Germany, proposes to combine in a single operation the method of Acheson for the production of carbide of silicon and that of Cowles for the distillation of zinc from its ores. To this end he substitutes for the sand of the carborundum charge, the silicate of zinc; the metal is distilled over and collected, while the silicon unites with the excess of carbon to form carborundum which remains as a residue. This is the process claimed; the specification states, however, that zinc oxide derived from the dead roasting of blende, together with sufficient carbon for its reduction, may be merely added to the usual carborundum charge. In this case the curious proposition is offered to conduct simultaneously, in the same furnace, two independent and unrelated operations, neither of which is stated to modify the other in any manner.

It is seldom, indeed, that it is commercially feasible to combine independent methods in this manner. In the case mentioned it may be assumed that neither process modifies the other, and that therefore the sole advantage to be gained is a certain saving of heat due to the restriction of the radiation losses to the walls of a single structure. To counterbalance this gain is the obvious necessity for so constructing the carborundum furnaces that their walls and covers shall be impervious to the vapors of zinc; and considering that an effective zinc retort has long been a problem for metallurgists, the difficulties are seemingly somewhat disproportionate to the advantage derived.

In this case the operations are not incompatible, but in a sense the products are; the expense of the collection of either is vastly increased by the necessity for collecting the other. There are many

known methods wherein no such incompatibility exists; among these may be mentioned the process of Heibling for the simultaneous production of chrome iron and calcium carbide, the latter compound being formed as a slag resulting from the reaction of lime with carbon which it is desired to eliminate from the metal; and the method of Rathenay for the production of silicides of iron by the addition of the latter metal to the usually impure calcium carbide charge. Here also the object is to eliminate what may be regarded as an impurity, forming therefrom a useful product. As a further example may be cited the suggestion of Desjardins for the simultaneous production of water-glass and phosphorus by heating together sodium phosphate, silica and carbon in the electric furnace.

Such examples might be multiplied almost indefinitely, but it is probable that no more interesting combination process has been offered than the proposal, variously patented by Joudrain, Hilbert, Billaudot, Jacobsen, and perhaps others, that the manufacture of calcium carbide and phosphorus be combined in a single operation. According to this scheme, calcium phosphate is reduced by excess of carbon in the electric furnace, phosphorus being distilled and calcium carbide remaining as a residue. This plan is strictly analogous to that of Dorsemagen, above referred to, and is probably open to the same objection of unnecessarily complicating the carbide furnace; it has also been found to be objectionable in that it contaminates the carbide with phosphide, thereby also contaminating the acetylene with gaseous hydrides of phosphorus.

The latest suggestion along these lines is in the patent issued jointly to Charles S. Bradley, Robert H. Read and Charles B. Jacobs and assigned to the Ampere Electrochemical Company of New Jersey. In this case a virtue is made of necessity, and the product of the phosphate reduction is stated to be a "carbophosphide" of calcium. It seems to be in fact a mixture of phosphide and carbide, which may be crystalline, and which contains sufficient of the first-named compound to insure the liberation, by reaction with water, of a spontaneous inflammable mixture of gases, the predominant constituent being, of course, acetylene. For this compound certain uses, of a military and naval character, are suggested.

New Telephone Patents.

Telephony may be credited with no less than six of the patents issued on December 16th. Not the least interesting of these is one which, under the title, "Telephone System," describes and claims a novel design of induction, coil and receiver for common battery system subscribers' instruments. This novelty of design concerns the electrical features only, the primary winding of the induction coil being of higher resistance and of higher inductance than customary, while the secondary circuit embracing both the coil winding and the receiver, has both these factors correspondingly reduced.

The reasons for these changes may be best understood by considering the induction coil as a transformer. With transformers, it is well known that when the secondary winding is on open circuit, that is, when no power is being used, the primary winding receives very little energy from the line. As the resistance of the secondary is reduced by the cutting into service of more and more lights or other apparatus, the primary current adjusts itself to supply the requisite power. This regulation of the primary current is due entirely to the fact that the two windings of the transformer so react upon each other that the impedance of the primary varies in an inverse ratio with the current or in a direct ratio to the impedance of the secondary circuit. Now with a telephone induction coil an exactly similar phenomenon takes place, and in the present invention this is utilized, the inventor making his secondary circuit resistances so low that the impedance offered to the telephone currents by the primary winding—which is in series with the line in a position to be effective in reducing the efficiency of transmission—is cut down materially, even though the resistance and number of turns of the primary winding are increased to compensate for the change of character of the receiver and secondary windings. The actual ratio of conversion of the new induction coil is 4:5, the windings both being of approximately eleven ohms resistance. The preferred resistance of the receiver is twenty-five ohms, obtained by using two fifty-ohm windings in parallel. The inventor of this system is Mr. W. W. Davis, of Chicago, the patent being assigned to the Stromberg-Carlson Company.

Another combined power and communicating system appears this week in a patent granted to A. M. Stark, of Toronto, Canada. This system purports to be one whereby either telegraph or telephone communication may be carried on over the conductors of a direct-current electric light and power system while this latter is in operation. The claims of the patent are based largely upon the bridging of storage batteries across the power circuit at the central station "to aid in maintaining constant pressure * * * and to remove the effects of the imperfect commutation of the generator." The inventor seems to forget altogether, however, that these central station

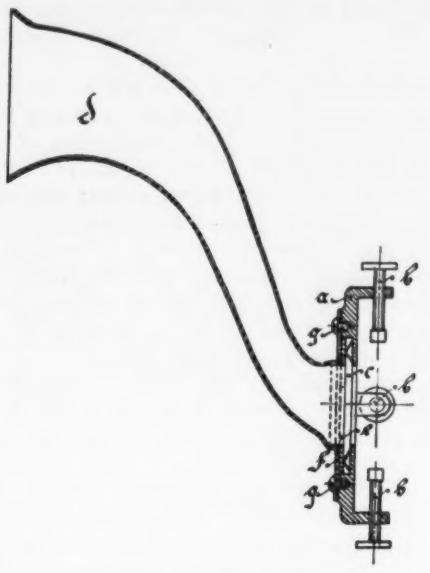


FIG. 1.—SCHOELER TRANSMITTER MOUTHPIECE.

batteries will not provide for the "effects of imperfect commutation" at the motor on the subscriber's premises or for the line wire resistance. As the telephone system described is rather crudely worked out, it does not seem worth while to give it detailed consideration.

Another patent in the same issue also related to the use of line wires for two kinds of transmission, but in this case it is not the simultaneous but the successive use of the wires which is provided for. The two types of transmission are telegraph and telephone signals, it being contemplated to arrange telephone instruments upon railway telegraph lines so that information may be properly reported from any station in the absence of a telegraph operator. Provision is made

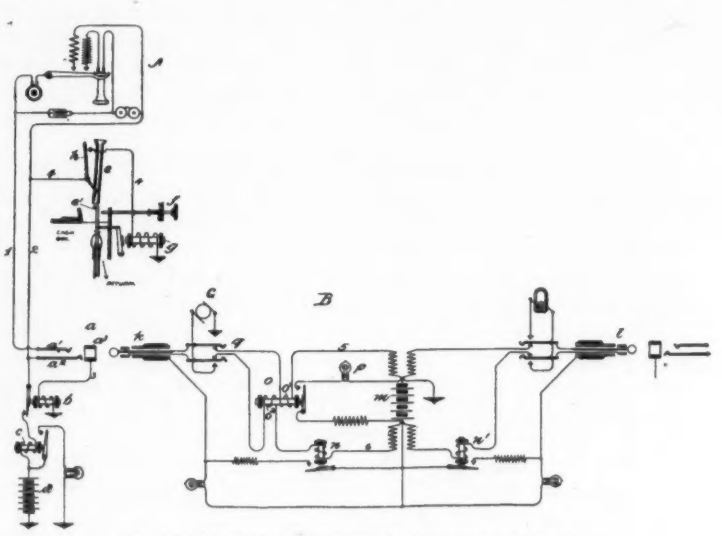


FIG. 2.—SCRIBNER SUPERVISORY SIGNAL SYSTEM.

for properly sending signals and for switching the line from one kind of apparatus to the other at any station, but as there is no telegraph busy signal and as the telegraph current exists upon the line during telephone conversation, it is interesting to consider what will happen if an operator at one station attempts to telegraph over the line while a telephone message is being sent from another, the unanswered and repeated telegraph signal calls being impressed forcibly upon the ears of the telephone users.

Fig. 1 shows a German idea of a convenient transmitter mouthpiece, being the subject of a patent granted to Arthur Schoeler, of Elberfield, Germany. The clamp *a* is adapted to clamp to the trans-

mitter and the crank-shaped mouthpiece may be rotated about the axis indicated in a manner to compensate for the varying heights of telephone uses.

Another mouthpiece patent is that of R. S. Willmarth, which bears the title, "Antiseptic Protector for Telephone Mouthpieces." The specified device is an absorbent, perforated disc, saturated with antiseptic solution and adapted to be secured in the front of the mouthpiece by means of a wire which engages notches at the base of the mouthpiece.

The sixth and last patent requiring consideration is entitled, "Supervisory Signal for Telephone Exchange Systems," and is granted to C. E. Scribner, of Chicago, and assigned by him to the Western Electric Company. Mr. Scribner's device is for use in connection with slot pay-station machines having coin-return attachments, and provides means whereby if a coin be removed from the slot during the completion of a connection, a signal light will notify the central office operator to cancel at once the call. Fig. 2 shows the means whereby this is accomplished, the action depending upon the contact at *h*, which is maintained as long as a coin is in the slot, and upon the differential winding of the relay *o* in the operator's cord circuit.

When a coin is in the slot the disturbing influence of the ground through the releasing magnet, *g*, at the pay station, is sufficient to unbalance the magnetic effects of the differential relay, allowing this to operate and show the signal *p*. When the coin has once been deposited either in the box by means of ringing current put upon the line by the operator, or in the return by means of the push button *f* in the hands of the subscriber, the balance in the relay is restored and the light extinguished.

Street Car Travel in New York State.

According to the statistics of the State Railroad Commission, during the fiscal year ended June 30, 1902, the surface and elevated railroads of the city of New York carried 924,754,211 original passengers; that is, passengers paying fares. Counting the transfers, the total number of passengers carried was 1,160,030,344. Figures are subjoined:

	Original.	Including Transfers.
Manhattan and Bronx.....	625,547,434	802,154,809
Brooklyn	299,206,777	357,875,435

The original passengers riding on the cars in Manhattan were distributed as follows: On the street surface roads, 410,287,089; on the elevated, 215,259,345. There being no transfers on the elevated makes the total transfers on the street surface roads 176,726,464. These figures, when compared with those of the preceding year, show that the passengers carried decreased 7,895,446 on the street surface and increased 25,213,604 on the elevated. The decrease on the street surface roads of Manhattan and the Bronx was not in original passengers, but in transfers, as these figures will show:

	1902.	1901.
Original passengers	410,287,089	392,117,069
Increase	18,170,020	.....

This year there are fifteen railroad companies operating in the territory of Manhattan and the Bronx, which is an increase of two companies over last year. The length of tracks operated by these companies is 216.491 miles, against 206.613 miles last year.

The surface and elevated roads of Brooklyn carried during the past year 357,875,435 passengers, including transfers. The original passengers numbered 299,206,777. There is no way to separate the elevated from the surface road passengers, for the report of the Brooklyn Heights Company makes no distinction. The lines of this company carried during the year 296,534,777 passengers, including transfers, and 240,394,676 original passengers. The increase in total number of passengers was 10,719,524. The statistics of original passengers for both years are:

	1902.	1901.
Original passengers	299,206,777	283,546,691
Increase	15,660,086	.....

Eight companies operate the railroads of Brooklyn, which is unchanged from last year. The track mileage this year is 330.317; last year, 328.394.

These figures show that there were more than two millions of passengers carried on the cars of the several lines of railroads operating in Greater New York every day in the year. A great increase is going on at the present time.

Telephone Lines in Village Streets.

In New York State the Fourth Appellate Division has decided, by Justice Hiscock, that a telephone company has the right, with the permission and under the control of the authorities, to erect poles and string wires through the main street of a village of several thousand inhabitants, notwithstanding that the abutting property owners refuse to give their consent. The village in question is Salamanca, N. Y. The property owners there own to the center of the street. The defendant had no right to erect the poles unless their erection was within the limits of the public easement in the street, and it is settled that the ownership by a property owner of the fee to the center of a street does not give him the right to prevent any additional use of the street, provided such use is within the limits of the public easement. Justice Hiscock held that while a city street may be subjected to many purposes that would not be necessary or proper in a country highway, there was nothing to show —as no hard and fast line could be drawn—what class the Salamanca street came under. The Justice said: "In considering what are the proper limits of lawful public use of a street or highway, a natural and well-defined distinction has been drawn by the courts between rural or country roads and city streets. Passing upon the right of a telephone company like defendant to place its wires in a public street in a city, this court has fully held and decided that such right was within the limits of the public easement in a city street. In the classification of, and distinction to be drawn between, city streets and rural highways, the courts have treated village streets as more analogous and akin to the former than to the latter. Such conclusion is a natural one. No fixed and arbitrary line upon the subject of public uses and necessities can be drawn between the streets of a city and a village. The more populous the latter becomes the more extensive will be its public needs and the demand for public conveniences. In a smaller degree than in the case of a large city its streets will always, in the natural course of events, be subjected to greater public demands and uses than the ordinary rural highway."

CURRENT NEWS AND NOTES.

TROLLEY FOR LIMA, PERU.—A cable dispatch from Lima says: A company has been organized here and has petitioned the government for a concession to build an electric railway in this city.

AMERICAN RÖNTGEN-RAY SOCIETY at its annual convention in Chicago adopted resolutions in favor of the St. Louis Exposition, after hearing a statement from Prof. W. E. Goldsborough on the subject.

NAPOLEON AND ELECTRICITY.—The first sculptural assignments announced for the St. Louis Exposition are the heroic statues of Jefferson and Napoleon. The designing of the Jefferson statue, which is to be placed in front of the main entrance of the Education Building, is assigned to J. Q. A. Ward, and Daniel C. French will design the statue of Napoleon, which will be placed in front of the principal entrance of the Electricity Building on the opposite side of the main lagoon. The figures will face each other, Napoleon in the act of signing the transfer and Jefferson in the attitude of receiving it. It will be remembered that the Electricity Building at Chicago in 1893 had a fine statue of Franklin in front of it. The only association of Napoleon with electricity is that Volta explained to him the principle of his cell, since when electricity has been rapidly undoing all that Napoleon ever did in the way of mere physical conquest.

MUIRHEAD WIRELESS SYSTEM.—The Muirhead wireless telegraph system on the *Vedamore* steamship, which arrived recently at Baltimore, Md., is reported to have shown off well in tests of 300 miles off Holyhead.

FIRE AT RENSSELAER POLYTECHNIC INSTITUTE.—The electrical laboratory of the Rensselaer Polytechnic Institute at Troy, N. Y., was almost completely destroyed by fire on the night of December 17, the loss being over $30,000.

AUTOMOBILE CLUB OF AMERICA will have its fourth annual dinner at the Waldorf-Astoria on Saturday, January 24, when several well-known speakers will participate. A large attendance is expected. Mr. J. M. Hill is chairman of the banquet committee.

CHICAGO UNIVERSITY ENDOWMENT.—Mr. John D. Rockefeller has given another $1,000,000 to the University of Chicago, making a total of $12,400,000 donated to that institution by Mr. Rockefeller. Out of the new endowment it is expected that Dr. Harper, president of the University, will establish a school of technology.

NEW AIRSHIP.—A cable dispatch from Paris of December 20 says: A habitable airship seems to be the next project which French aeronauts desire to realize. Mr. Broet, a member of the Aero Club of France, has designed and is having constructed an airship which will have a room covered in with mica and furnished with couch, wardrobe and table. The airship will be lighted with electricity.

SEIZURE OF WIRELESS TELEGRAPH PLANT.—A significant act on the part of the French government is recorded in a press dispatch from Cherbourg, which states that the authorities have seized the wireless telegraph station erected there by a private company on the promontory. The seizure was made on the ground that the operation of the station is an infringement on the state monopoly of the telegraphs and endangers the national defence.

STRIKE OF TELEPHONE GIRLS.—A special from Des Moines, Iowa, says that the strike of the telephone operators there, which had been in progress about six months, has been settled by representatives of the company and of the Trade and Labor Assembly. The telephone girls are to be paid wages 15 per cent in excess of the Union scale, and all of the girls who struck are to be taken back to work. The company further agrees not to discriminate in any way against the strikers. The injunction suit to restrain the representatives of union labor from boycotting the company is to be dismissed.

PETROL ELECTRICS FOR ENGLAND.—A cable dispatch from London of December 18 says: The *Times* announces that the Northeastern Railway is about to try two autocars now being built at York. At one end of each car is a Napier petrol engine of 85 hp and with 4 cylinders, driving a dynamo generating electricity for two motors applying the power to the wheels. The cars are light, and each carries 52 passengers. The storage capacity is for 30 gallons of petrol, which will last 5 hours. It is proposed to work the new system experimentally on the crowded part of the railway between Hartlepool and West Hartlepool, which are not far apart.

A. I. E. E. LOCAL MEETINGS.—At the meeting last week of the American Institute of Electrical Engineers, President Scott announced that during the past month local meetings have been held in Chicago, Denver, Cincinnati and Pittsburg, and students' meetings at a number of the colleges. Prof. Esty referred to the interest manifested by students at Lehigh University, where three student meetings have thus far been held, in each case immediately after the New York meeting. The reading of the Institute papers was followed by discussions, and Prof. Esty spoke enthusiastically of the benefit to the students, and of their appreciation of the plan.

AMERICAN ELECTROCHEMICAL SOCIETY.—At the December meeting of the Board of Directors of the American Electrochemical Society, the following applicants were elected to membership: Dr. Leonard Paget, New York; Prof. Dr. Julius Wagner, Leipzig, Germany; R. W. Vicarey, Stafford, England; Prof. Philippe A. Guye, Geneva, Switzerland; Leonard Wilson, Pittsfield, Mass.; Dr. William Dreyfus, New York; Charles J. Pretzfeld, Niagara Falls, N. Y.; August Eimer, New York; Dr. John Shields, London, England; Prof. D. McIntosh, Montreal, Canada; Dr. J. W. Walker, Montreal, Canada; Walter S. Landis, Bethlehem, Pa.; George P. Adamson, Easton, Pa.; Victor Engelhardt, Vienna, Austria; F. J. Machalske, Long Island City, N. Y.

A. I. E. E. IN CINCINNATI.—A local branch of the American Institute of Electrical Engineers has been formed at Cincinnati. The movement was inaugurated by Mr. F. G. Bolles and the first meeting held in the officers' dining room at the works of the Bullock Electric Manufacturing Company on Wednesday evening, December 17th. Eleven members were present, and after forming a temporary organization and discussing the different phases of the subject for some time, elected R. T. Lozier and L. E. Bogen as chairman and secretary of the permanent organization. It is the intention to discuss papers presented at the New York meeting, as this will be feasible, owing to the fact that the local meeting will be about three weeks later than the one held in New York. Mr. Bolles handed in ten new applications for membership and stated that at least ten more would probably be secured before January 12th, the date of the next meeting.

NEW TYPE OF ALTERNATOR.—Two patents issued December 9 to Charles S. Bradley describe a new and interesting type of alternator, which is self-exciting and particularly adapted for high speeds such as are incident to direct-connection to steam turbines. The armature, if such it may be called, is of the squirrel-cage type. As shown, the field is of the ring type with a continuous winding. This winding is tapped at three equidistant points by leads from three condensers in parallel; and at three other equidistant points by the three mains of the working circuit in case three-phase currents are desired. The capacity of the condensers is so chosen with respect to the field inductance as to give the condenser circuit a definite rate with respect to frequency. The periodicity of the generated current is a differential of two speeds—one of which depends upon the speed at which the armature is driven and the other upon the resonant rate established by the condenser circuit. Consequently the speed of the prime mover is the sum of the speeds of the rotary field established respectively by the condenser and driven element, and therefore particularly suitable when the prime mover is a steam turbine. By making the condenser circuit adjustable, the frequency can be very simply varied.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Miss H. Billings, assistant secretary of the National Electric Light Association, sends us the following additional list of new members enrolled since November 1, making no less than 180 since the Cincinnati meeting: Franklin Falls, N. H., Franklin Light & Power Company; Lambertville, N. J., Hunterdon Electric Company; San Francisco, Cal., the Standard Electric Company of California; Victor, Colo., Pike's Peak Power Company; Phoenix, Ariz., Phoenix Light and Fuel Company; San Leandro, Cal., Suburban Electric Light Company; Lewiston, Idaho, Lewiston Water and Power Company; Hillsboro, Ill., Hillsboro Electric Light & Power Company; Saginaw, Mich, Bartlett Illuminating Company; Ann Arbor, Mich., Washtenau Light & Power Company; Marshfield, Ore., Marshfield Lighting Company; Fort Smith, Ark., Fort Smith & Van Buren Light & Transit Company; Oneida, N. Y., Madison County Gas & Electric Company; Idaho Springs, Colo., the Cascade Electric Company; Idaho Springs, Colo., the Consolidated Gem Mines Company, electrical department; Southampton, N. Y., the Southampton Electric Light Company; Paris, Texas, Paris Light & Power Company; Prescott, Ariz., the Prescott Electric Company; Grand Forks, N. D., Grand Forks Gas & Electric Company; Phoenixville, Pa., Schuylkill Valley Illuminating Company; Wausau, Wis., Wausau Electric Company; Port Huron, Mich., Port Huron Light & Power Company; Paducah, Ky., Paducah City Railway; Brandon, Vt., Neshobe Electric Company; Binghamton, N. Y., Binghamton Light, Heat & Power Company; Helena, Mont., Helena Light & Traction Company; Dover, N. J., Dover Electric Light Company; Suffield, Conn., Village Water Company; Thomasville, Ga., Thomasville Electric Light & Gas Company; Keeseville, N. Y., Keeseville Electric Company; Chelsea, Mass., Chelsea Gas Light Company; Santa Fé, N. M., Santa Fé Water & Light Company; Alpena, Mich., Alpena Electric Light Company; Unionville, Conn., the Union Electric Light & Power Company; Peekskill, N. Y., Peekskill Lighting & Railroad Company; Columbus, Kan., the Columbus Electric Company; Pittston, Pa., Citizens' Elec-

tric Illuminating Company; Vergennes, Vt., Vergennes Electric Company; Brunswick, Me., the Brunswick Electric Light and Power Company; Portland, Me., Consolidated Electric Light Company of Maine; Litchfield, Conn., the Litchfield Electric Light & Power Company; Lexington, Mass., Lexington Gas & Electric Company; Ontario, Cal., Ontario Power Company; New Lisbon, Ohio, the New Lisbon Gas Company; Aylmer, Quebec, Hull Electric Company.

LETTER TO THE EDITORS.

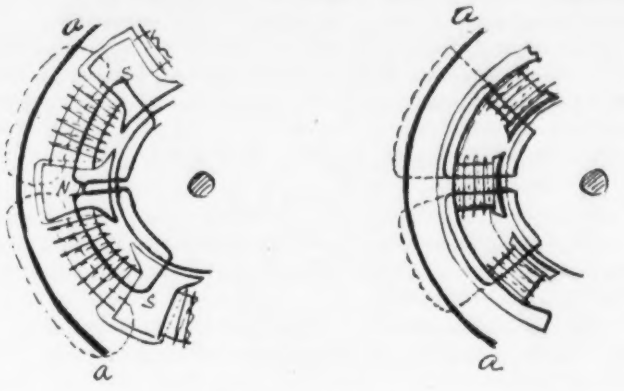
Increasing Output of Motors.

To the Editors of Electrical World and Engineer:

Sirs: Several months ago, while testing some small induction motors of my own make, I observed that the power output the motors were capable to yield was increased by removing the sheet iron cover around the stator coils. Some few words about the construction and winding of these motors will aid to understand the explanation that has occurred to me concerning the influence of the iron cover.

The motors are designed for an effective output of one-half horse-power on 104-volt, 60-cycle, single-phase circuits. The stator is 9 inches outside diameter; longitudinal breadth of iron, 4¾ inches; inside diameter of stator ring, 5 inches; rotor outside diameter, 4 31-32 inches; air-gap, 1-64 inch; slots in the rotor, 37, nearly closed, for No. 2 brass wires short circuited at the ends; slots in the stator, 36 open. A four-pole winding in ring fashion is used in the stator, the coils passing outside the stator and through the slots at the inside. The sheet-iron tube covering the stator coils is made 1-32 inch in thickness, and receives 11¼-inch diameter, leaving an air-gap all around the iron in the stator of 1⅛ inches.

A satisfactory explanation of the influence of the iron cover is the probable increase in the magnetic leakage due to its situation in the stray field around the stator coils. A sheet zinc cover has no influence at all upon the output. This influence of the iron cover will exist only in ring-wound stators. In drum-wound stators the cover will exert, if any, a favorable influence. Two simple analogies, with well-known types of direct-current magnet frames (Figs. 1 and 2), will require little



FIGS. 1 AND 2.

explanation to show that any magnetic cover or shield, *a a*, in Fig. 1, will decrease the flux linked with the armature, while in Fig. 2 there will be a very small action, and this in a favorable way. If we have in mind the direction of the m.m.fs produced by the windings, the analogy between Figs. 1 and 2, and ring and drum-wound stators, respectively will be plain.

LIMA, PERU. A. GRIEVE.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Experiments with Synchronous Converters.—THORNTON.—A long and fully illustrated abstract of a paper read before the Newcastle section of the (Brit.) Inst. Elec. Eng. on some experiments made with two small direct-current dynamos used as converters; both were two-pole, ring-wound machines, one of 9 kw, and the other of 5 kw. In order to avoid disturbances due to irregular driving, the first was driven from a battery of accumulators; both machines were excited directly from the accumulators. The two machines were connected on the alternating-current side by cables of negligible resistance in such a way that they could be used either as single or three-phase converters. The direct current furnished by the second machine was absorbed by means of a liquid resistance. Ammeters and voltmeters were arranged to read the currents and voltages on both continuous and alternating-current sides of both machines, as well as the currents in their shunts; a wattmeter was used to read the power in the alternating-current circuit. A double oscillograph was used to give the curves of current and voltage. The results of the tests are tabulated and also shown in diagrams; there is also a table showing the interesting curve forms obtained with the oscillograph. The two machines were started without load and the load was thrown on gradually; if the load was thrown on suddenly, the second converter started surging and was liable to fall out of step. In the first set of experiments the field of the first converter was kept constant, while the field of the second was varied; and, afterwards, the second was kept at constant excitation, and the field of the first was varied. In these experiments which were made with single-phase current, the efficiency of the combination is higher, when the power factor is highest. The variations of efficiency is nearly proportional to the squares of the current on the alternating-current side, showing that the variation of the copper losses is the cause of the loss of efficiency. Discrepancies between the observed and calculated losses in the converters led to an investigation of the disturbing effect of the armature reaction on the field in the magnet frame; the second machine being compound wound, its series winding was used as an exploring coil to show the variations in the magnetic flux. In the discussion which followed, Holmes pointed out that this paper represented the study of dynamos from a new point of view, viz., the actual observation of the magnetic flux; if an armature is out of balance or contains a faulty coil, changes go on in the field magnets; he has frequently observed a rise of voltage in the field coils of multipolar machines when an armature is out of balance.—Lond. *Elec.*, December 5.

REFERENCE.

Non-Synchronous Alternating-Current Machines.—ZIEGENBERG.—Continuation and conclusion of his long illustrated serial the first parts of which have already been noticed in the Digest. He discusses the motors of Latour and Heyland, which have been repeatedly noticed in these columns.—*Elek. Anz.*, October 23, 30.

LIGHTS AND LIGHTING.

REFERENCE.

Train Lighting.—An illustrated description of Kull's electric system of train lighting.—*Elek. Anz.*, November 6.

POWER.

Dust Destructors and Electric Stations.—WARING; APPLEBEE; AND THOMLINSON-LEE.—Three communications referring to Goodrich's recent paper on this subject. Waring thinks that from a combined arrangement of electric plant and refuse destructor, no beneficial results whatever accrue in the long run to either the electric plant per se or to the tax payers in general. The only exceptions ars such isolated cases in which the steam generated from the destruction of the refuse cannot be made use of for such purposes as mortar-mixing, pumping, grinding up material for flag-making, etc. Applebee thinks the combined electric plant and refuse destructor has come to

stay; the heat from the destructor of an ordinary form provides only a fraction of the total heat required; but in many places that fraction is worth considering, and in a station supplying traction to a moderate-sized tramway for 18 or 20 hours per day, the fraction may be a most important one. Thomlinson-Lee urges that in the original scheme for a destructor there should be built and erected, in conjunction with the same, mortar mills and a flag-making plant, in order to utilize the clinker and residue; this plant would give the destructor plenty of work in generating steam for its own use. "The unfortunate engineer who is saddled with the management of a combined electric lighting and refuse destructor plant will learn that, after about 18 months' working of his precious destructors, the whole of his time and attention, if he can give it, will be required for the purpose of rebuilding the furnaces and the very many undesirable repair works necessary to keep them going."—Lond. *Elec.*, December 5.

REFERENCES.

California Power Transmission.—A profusely illustrated description of the Northern California Power Company's transmission.—*Jour. of Elec.*, December.

Niagara Falls.—Dunlap.—Illustrated articles on the new plant of the Canadian Niagara Falls Company.—*Sc. Am.*, December 6; *Eng. News*, December 11.

Traction.

Stationary Traction Storage Batteries in Italy.—De Christoforis.—An abstract of a paper read before the Italian Ass. Elec. Eng. He states that where the third-rail system is applied to traction work on main lines, the use of storage batteries at the station is almost a necessity. The Milan-Varese electric railway, which is equipped with the third-rail system, is taken as an example; it is 31 miles long and power is obtained from four sub-stations to which power is transmitted from a steam central station 6½ miles distant from the railway line, where water power will be utilized in future. The voltage of transmission is 12,000, and at the sub-stations the current is converted by means of transformers and rotary converters into direct current at 650 volts. The regular trains, consisting of a motor car and a trailer, are run at a speed of 56 miles an hour, taking 600 amperes at starting and 400 amperes during an average run at normal speed; it is intended to run five trains per hour each way for 18 hours. The storage batteries have been designed to permit of the switching off of one of the rotaries, and to furnish all current above the average load; the reserve is then constituted by the second rotary and the transformers. The battery also takes up all the fluctuations of the load and furnishes, alone, the necessary current to all the trains during a period of not less than one hour in the event of an interruption of the primary current. Each of the batteries at the sub-stations has a total capacity of 1,500 to 2,500 ampere-hours for a one-hour discharge rate. The use of the batteries at the sub-stations allows the central station to work under the average load throughout the whole day, and owing to this 1,400 kw of generating sets are saved. It is expected that the use of storage batteries will increase the efficiency of the entire plant by at least 11 per cent. From the saving of coal at the power stations, the author concludes that the cost of the batteries will be saved in two years.—Lond. *Elec.*, December 5.

New England Road.—A description of the trolley line between Concord and Manchester, recently installed by the Boston & Maine Railroad. Power is purchased at 10,000 volts and 3-phase alternating and is converted to 550 volts direct-current, for use on the trolley wire. Aluminum feeder cables are used for direct-current distribution. The cars are each equipped with four 160-hp motors with multiple-unit control. Single cars are generally used, but with heavy traffic trains of two or three cars are operated with one motorman.—*St. R'y Jour.*, December 6, and *Int. Ed.*, December.

Standards for Traction.—Heft, Beggs, Connetts, Newman, Luffin.—The report presented at the meeting of the American Street Railway Association in Detroit in October, accompanied by a number of valuable drawings. The committee recommends that the Association adopt as a standard for either a T or girder-rail, the form of rails shown in a diagram, the height of rails to be governed by the character of the pavement required in the municipalities and the weight of the rail to be not less than 70 lbs. for T and not less than 90 lbs. for the girder rail per yard. In the matter of motors, it was the opinion of the committee that the time had not yet arrived to recommend a standard form or design. The committee, however, recommended standards for axles, journals, journal boxes and other features, details of all of which are presented in the cuts and cover a wide range of equipment for cars up to 50 tons. The committee also recommended a steel-tired wheel and cast chilled wheel and gives the dimensions for different classes of service. Standard forms for a brake head and brake shoe are also recommended. Considerable attention is given to the subject of hauling cars. The committee recommends "a supplementary return in addition to the usual practice at the present time in all congested sections crossing all special work in the vicinity of the power plants." The subjects of "standard overhead construction for high-speed city and suburban service, including trolley wheels," and "car bodies for city and suburban service, including ventilation, also the question of oval roof," were not reported upon, but it was recommended that these subjects be given special attention during the coming year.—*St. R'y Jour.*, November 15, and *Int. Ed.*, November.

REFERENCES.

Jungfrau Railway.—Sidler.—The first part of a well-illustrated description of this well-known three-phase Swiss railway.—*Zeit. f. Elek.*, November 30.

Provision for Snow Storms.—Conway.—A paper read before the New England Street Railway Club on the equipment and the organization for properly handling cars during snow storms, as done by the Old Colony Street Railway, of Boston.—*St. R'y Jour.*, November 29, and *Int. Ed.*, December.

Installations, Systems and Appliances.

Transformer Hazard.—Some editorial notes on a paper by Low on this subject, which has already been abstracted in the Digest. The class of transformers which might well be relegated into separate fire-proof buildings apart from power houses, embodies all large high-tension transformers, which are connected to pole-line circuits, or transformers which are so connected to other transformers that in the event of trouble to one transformer, the energy of other transformers, or of the generating station, can be centered in it, furthering its destruction. The short-circuiting of a high-tension transmission line and the burning out of a sub-station transformer, are two troubles which are ordinarily indistinguishable to the operator in charge of the generating station. The oil transformer is said to be the most perfect appliance in all the category of electrical machinery; when properly installed it will go through a station fire more nearly unscathed than any other piece of electrical apparatus. Concerning proper installation, it is suggested to erect the transformer on a foundation as solid as those built for engines, to equip them with water coils for cooling and to feed these water coils from an exterior source of supply; to place the transformers in heavy wrought iron cases, so covered with heavy caps as to be water tight; and then, if one chooses to do so, it will be a further desirable precaution to place them in a separate building. Above all, they should be kept off wooden floors and out of buildings which, when burning, will upset them and pour out their oil.—*Jour. of Elec.*, November.

REFERENCES.

Middle Wire.—An article illustrated by diagrams, on the installation of bare middle wires in three-wire systems.—*Elek. Anz.*, October 16.

Electrically Operated Appliances.—Holberton.—A paper read before the Pacific Coast Gas Association. He recommends the use of electric appliances for controlling valves, etc., in gas plants.—*Jour. of Elec.*, December.

Electrical Experiences.—Leitch.—An article, illustrated by diagrams in which he describes some experiences made by the engineer of the electric installation of a department store.—*Power*, December.

Electro-Physics and Magnetism.

Conductivity of Pressed Powders.—Streintz.—An account of a continuation of his researches on the conductivity of metallic oxides and sulphides in powdered form and under pressures equal to those which gave a quasi-metallic coherence on platinum black and other substances. As a general rule, compounds having a light color, such as white, yellow, red or grey, conduct badly, and most dark powders conduct well, which is in accordance with the electromagnetic theory of light. On the other hand, a number of powders of a dark color are non-conductors. No compressed powders were discovered which could be classed both among metals and among electrolytes; in fact, truly electrolytic conduction was not found in any powder.

Only such powders were conductors at the ordinary temperature as could be brought to a state of metallic lustre and hardness without the use of a binding medium; such bodies possess a positive temperature coefficient. There is, for all these compounds, a temperature of transition from a low to a high conductivity. If any oxide or sulphide is a good conductor, the next higher oxide or sulphide is a still better conductor.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 5.

Demonstration of Electric Oscillations.—ZEHNDER.—A description of some simple lecture arrangements for demonstrating the experiments of Feddersen, Paalzow, Hertz and Lecher. Feddersen's condenser discharges may be shown by means of a simple rotating mirror; a cylinder of dry wood or ebonite has a mirror inserted in a depression, in front of which and with its axis parallel to that of the cylinder is placed the spark gap of the condenser, and in front of that, again, a lens which projects the spark upon a translucent screen. The revolution of the cylinder makes contact and discharges the condenser at the instant this image is projected by the mirror through the lens on to the screen. Paalzow's experiments are demonstrated by means of a vacuum tube 62 cm long and 3.5 cm wide placed next to the poles of a horseshoe magnet separated by 12 cm. With a small spark gap in the condenser circuit or without any spark gap, a single refraction of the spark path is obtained, and with a large spark gap the other phenomena described by Paalzow, such as a double refraction is obtained corresponding to discharges in both directions. The successive discharges are separated on account of the heating of the air in the spark gap, which drives the discharges upward and separates them in a vertical plane.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 5.

REFERENCES.

Loss of Radio-Activity.—CURIE.—An account of an experimental investigation of the loss of radio-activity by radio-active bodies. He finds that the loss of radio-activity follows a certain rather simple law.—*Comptes Rendus*, November 17; abstracted in Lond. *Elec.*, December 5.

Zeeman Effect.—FAERBER.—A paper on the reduction of the results of Runge and Pascher's magnetic separation of spectrum lines, to absolute measure and on similar problems.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 5.

Photo-Electric Action of Salts.—ELSTER AND GEITEL.—An account of an experimental investigation of photo-electric dispersion, i. e., the expulsion of negative electrons during the illumination of a charged surface.—Lond. *Elec.*, December 5.

Hall Effect and Thermo-Electric Power.—VON AUBEL.—An account of experiments in which he confirmed Ettinghausen and Nernst's relation between the Hall effect and the thermo-electric properties of metals. He studied an alloy of bismuth and antimony and a fused mixture of bismuth and sulphide of bismuth.—*Comptes Rendus*, November 10; abstracted in London *Elec.*, November 28.

Photo-Electric Currents.—VON SCHWEIDLER.—An account of an experimental investigation of the photo-electric potassium cell of the type described by Elster and Geitel.—*Phys. Zeit.*, November 15; abstracted in Lond. *Elec.*, November 28.

ELECTRO-CHEMISTRY AND BATTERIES.

Hypochlorite of Soda.—WALKER.—An article describing a cell for the electrolytic production of hypochlorite of soda. It consists of a semi-cylindrical carbon-lined wooden vat, acting as anode, and a wooden cylinder as cathode, covered with lead and revolving in the vat within an inch of the surface of the carbons; the solution of salt fills up the space between; the electrolyte hardly becomes heated at all and thus no other reactions are produced and no chlorates are made. Preferably the apparatus is worked at the bleaching plant, where the solution is at once used in the bleaching vats, as it is not practicable to store and ship the hypochlorite. No other chemical is required in the bleaching vat, as the hypochlorite rapidly gives off its oxygen when it comes in contact with the pulp or textile fabric and passes back to common salt again. One of the great advantages over bleaching powder is that no insoluble precipitate is formed; for this reason and because chlorine has been found to be too strong for this purpose, it has been impossible to use bleaching powder in whitening high-class linen. A brief reference is made to the fact that the addition of sulphuric acid to the hypochlorite solution releases chlorine, and it is said to be probable that this would be a better source of chlorine for chlorination than bleaching powder, and at any mine where fuel, water and salt are obtainable such cells might be erected for the direct production and use of chlorine both in treating gold ores and in leaching low-grade copper ores.—*Eng. & Min. Jour.*, November 22.

Production of Metallic Calcium.—ARNDT.—A brief illustrated paper referring to Borchers and Stockem's method for the electrolytic production of metallic calcium, recently described in the Digest. He states that the same result may be obtained in a simple apparatus. He uses a coated iron crucible, a carbon rod as anode, and a thick iron wire as cathode. He obtained metallic calcium in larger, well-fused pieces, which could be easily hammered and filed. The analysis of a piece thus produced showed 99 per cent. of calcium and 1 per cent. of silicum, no iron or aluminum being present.—*Zeit. f. Elektrochemie*, November 13.

Testing of Alloys.—SIRKS.—A description of an electrolytic method suitable for testing alloys for industrial purposes, which is considered superior to the usual methods. The specimen is made the anode in an electrolytic cell, with copper as a cathode; direct current at 4 volts is used; the electrolyte is water with six drops of dilute sulphuric acid per 100 cc. Since the etchings are much more pronounced in this method than in the simple acid etching, it is not necessary to polish the specimens; smooth filing suffices. It is thus possible to etch out individual crystals of the alloy, showing a definite and invariable proportion of the constituents. These crystals are the product of a chemical reaction between the constituents which has a profound influence upon the mechanical properties of the alloy.—*Proc. Roy. Akad.*, Amsterdam, September 27; abstracted in Lond. *Elec.*, November 14.

Standardization of Methods of Chemical Analysis.—BLOUNT.—A paper in which he draws attention to the growing demand for standardization in general. The arbitrary methods in use for the examination of water, milk, oils, foods, manures, etc., should be standardized, but true analytical processes, such as the determination of all elements and most inorganic and many organic bodies, cannot be; he advocates conferences of specialists in different branches of analysis for the discussion of methods, though not for the promulgation of rules. —Lond. *Eng'ing*, November 7.

Electrolysis of Silver Nitrate.—It is generally said that silver nitrate becomes acid during electrolysis, yet Rodger and Watson found that the acidity of the bath diminished. This apparent contradiction has been explained recently by Leduc as being due to a difference of the conditions. With platinum electrodes in a sufficiently concentrated solution, a brown solid, containing a higher oxide of silver, is formed with simultaneous formation of nitric acid, when the bath has a certain concentration; when a sufficient concentration is reached, this reacts on the compound forming oxygen. He finds that corrosion or solution of the cathode deposit does not take place.—Lond. *Elec. Eng.*, November 7.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—Continuations and conclusion of the summary of wireless telegraphy patents of recent years.—Lond. *Elec.*, November 21, 28. In a long editorial the whole summary is discussed. The series of patents is said to show two points, namely the better understanding of the behavior of electrical oscillations on wires and the entire absence of any essential improvement in syntony. The magnification of the Tesla apparatus is said to be the chief novelty in the Fleming-Marconi patents; the essential features of the apparatus, regarded as a mode of radiating energy, being unmodified in method and remaining unchanged in principle. That Marconi now uses longer waves than formerly is a step in the right direction, as longer waves travel farther than short ones. This is said to have been overlooked by Blondel. Marconi's success began when he discarded high-frequency vibrators, such as the Righi oscillator, and when, by adopting the vertical wire, he commenced to use great wave lengths. In the case of air-wire systems in general, it is not altogether the mere height of the vertical radiator, but also the length of wave which it yields, that is responsible for the success of the elevated conductor. Concerning Fessenden's system, it is asked whether even under the most favorable circumstances, the different effects used by him are not extremely small; experiments alone can answer this question; "for the present Prof. Fessenden is to be congratulated on tackling the problem of wireless telegraphy in a refreshingly novel manner." The system of Lodge and Muirhead is said to be rooted definitely in accurate knowledge of the principles of the subject. It is finally pointed out that perfect syntony,—without

which complete rivalry with telegraph wire and cable seems impossible,—is scarcely more nearly approached now than in some of the earliest experiments; and to-day's wireless telegraphy, in spite of its recent enormous developments, seems as far from displacing the older industries it set out to rival, as it was two years ago.—Lond. *Elec.*, November 28.

Wave Telegraphy.—Blochmann.—A description of a new system of wireless telegraphy, which, while not possessing some advantages of the present systems, has certain valuable features when small distances are concerned. He calls it "ray telegraphy," its distinctive characteristic being that lenses are substituted for the antennæ. The material of the lenses must have a high dielectric constant, and may consist of resin, glass, paraffin and the like. An important observation made is that the lenses, to be effective in concentrating the electromagnetic rays upon a distant object, need not be very large in comparison with the wave length used. Thus mirrors 80 cm in diameter suffice for waves 20 cm long, and signals can be exchanged over several miles. At the receiving station a similar lens is used; in fact, the apparatus is practically a heliograph employing invisible instead of visible light. The dark rays have the advantage of secrecy and of not being intercepted by fog or by non-conducting solids. Mountains are an obstacle, but this can be overcome by a series of relays. The direction of the arriving waves can be clearly distinguished to within a degree, and many simultaneous messages may thus be received and separated. Messages may also be sent out simultaneously in various directions. It appears that a clear path through the air without intervening bodies is necessary, just as in heliography.—*Phys. Zeit.*, November 1; abstracted in Lond. *Elec.*, December 5.

Miscellaneous.

Some Limits in Heavy Electrical Engineering.—Swinburne.—The first part of his presidential address to the (Brit.) Institution of Elec. Eng. He remarks that the progress of electrical engineering has been so very fast lately that we may be a little apt to have vague views of what we can and what we cannot do electrically. Dynamo and transformer design is now well understood, but "we must not say that because we can buy efficient dynamos and order accurate instruments that we need have no technical knowledge. Quite otherwise, we must understand dynamos as before, also measuring instruments; but we must also understand steam engines, gas engines, fuel questions, financial matters, parliamentary matters, tramway matters, railway engineering and very soon railway management. All these are the work of the electrical engineer. No one man can be a complete electrical engineer; but each of us ought to know one subject well, and a large number of allied subjects fairly well." Concerning theory and practice, he says that the "theorist" and the "practical man" are both ignorant of "half science." To be an engineer one must know both branches. "There is nothing superior about knowledge which is not yet applied. It is mere raw material; it may be useful when worked up, and it is valuable when it is worked up, but only because it may be worked up. * * * * The sort of tacit assumption that an engineer can never be a 'scientific man,' while a 'scientific man' can teach the engineer his business, cannot fail to annoy the engineer, and this feeling of annoyance is largely the cause of a great deal of opposition to technical—that is to say, really scientific education." He then begins to discuss the limitations of "heavy electrical engineering." He first points out the small likelihood of there being any practical utilization of the energy of the tides. Concerning the generation of electrical energy from water power, he thinks people generally attach a too exaggerated value to it, because "as a rule, a water power is not where it is wanted industrially." Even electrometallurgical and electrochemical plants do not depend upon water power, but may use steam and earn profits. He then discusses the prospects of "carbon cells," which he believes to be impossible devices. The reprint of the complete address is to be continued. From some editoria! notes it appears that the rest of the address deals with the following subjects: Advance in steam engine design must be sought at the low-temperature end of the cycle, and a two-fluid engine offers a possible solution; but he thinks that the large gas engine is likely to oust the steam engine for large powers in the near future, and, with cheap gas, the two-fluid engine will not become necessary. In dynamo and transformer design we are near finality, and battery improvements seem almost to have reached a deadlock; but in cable insulation there is still a field for scientific application of inventive talent. In electrical illumination much remains to be done, whether it be in discovering a more direct way of converting the easily available forms of electrical energy into electromagnetic radiation of the desired wave length, or merely in improving our existing electric lamps. The address is concluded with paragraphs on electric railways and electrolysis.—Lond. *Elec.*, December 5.

Electric Production of Sleep.—Leduc.—A description of some improvements in his former method of producing sleep electrically. With 10 to 30 volts, and with currents interrupted 150 to 200 times per second, the inhibition of the cerebral hemispheres could be brought about in animals, thus producing sleep and a general anæsthesia. The procedure had the disadvantage of producing at first contractions and convulsions, raising the pressure of the blood, provoking the evacuation of the bladder and the intestine, and momentarily stopping respiration. These disadvantages are largely reduced by introducing into the circuit an inductionless resistance allowing the operator to attain the necessary intensity gradually in three to five minutes. This method requires a preliminary introduction of the maximum e.m.f., but this should be made as low as possible. When the e.m.f. is then gradually raised to the necessary figure the animal passes gently and gradually, without a movement of defence or of flight, without a cry, and without any change in the movements of respiration or heart action, from the waking state into a quiet and regular sleep, with absolute anæsthesia. The dog at first bows its head as if sleepy, sits down on its side, and eventually goes to sleep without having given the least sign of fear or pain.—*Comptes Rendus*, November 17; abstracted in Lond. *Elec.*, December 5.

New Books.

A Graphic Method for Solving Certain Questions in Arithmetic or Algebra. By George L. Vose. Second Edition. New York: D. Van Nostrand Company. 62 pages, 29 illustrations. Price, 50 cents.

This little book is No. 16 of the "Van Nostrand Science Series," and is like all the other numbers of this series in mechanical make-up. The subject matter is interesting and well presented in elementary form. Most persons who have never read any literature on this subject have no conception of the very great facility with which certain classes of problems, some of them quite complicated, are solved by ruling a few lines on ordinary co-ordinate paper. To all such persons who desire an introduction to the method, we can recommend this book.

Mechanics-Problems. By Frank B. Sanborn. New York: *Engineering News* Publishing Company. 155 pages, 62 illustrations. Price, $1.50.

The author's purpose is to introduce certain classes of problems not found in the ordinary text books, in addition to the kind ordinarily found therein. In this he seems to have succeeded, the variety of the problems being somewhat extensive. The book is in three sections: Work, Force, Motion. The author believes, with some others, that this is the natural order. There are 500 problems propounded, the solutions of a few being given, but the greater part are intended for the student to work out unaided. The author's purpose was not to write a text book (as he says in his preface), but to produce a book that would take the place of the hectograph or cyclostyle sheets, which many instructors now find it necessary to prepare and issue. For this purpose we think the book well adapted.

Books Received.

Transactions of the American Electrochemical Society. Philadelphia: The American Electrochemical Society. 274 pages; illustrated.

Electrical Dictionary, English, German, French. By Paul Blaschke. Leipzig: S. Hirzel. 226 pages. Price, 5 marks.

Jahrbuch der Elektrochemie. Berichte uber die Fortschritte des Jahres 1901. By Dr. W. Nernst and Dr. W. Borchers. Halle a. S: Wilhelm Knapp. 725 pages, 226 illustrations. Price, 24 marks.

Isoliermaterialien und Warme (Kalte) Scuutzmassen.. By Eduard Feltone. Leipzig: A. Hartlebens. 320 pages, 38 illustrations. Price, 5 marks, 30 pf.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

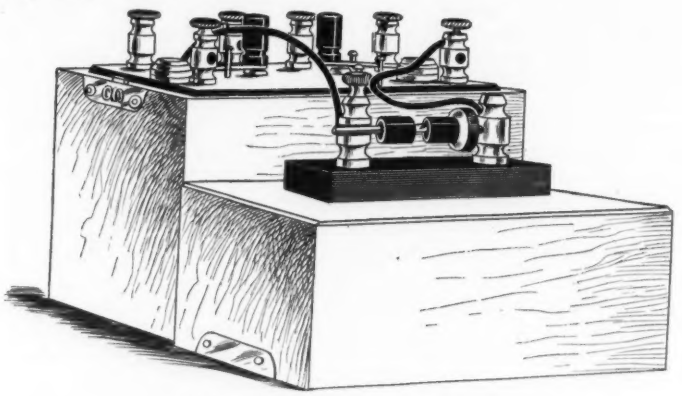
THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

Long Distance Wireless Communication Without Tuning.

To one acquainted with the technique of wireless telegraphy, some of the recent work at the De Forest Wireless Telegraph station at Coney Island is interesting. On Sunday, December 7, the operators there on watch for the Hamburg-American liner *Deutschland* picked up the boat at a distance of 60 miles. The *Deutschland* carries a Slaby-Arco system, but arrangements have been made with the Hamburg-American Company, whereby this steamer communicates with the De Forest wireless station on approaching and leaving New York.

On December 11 the Coney Island station caught messages from the American liner *Philadelphia* until that vessel was six hours from port, the last message being received perfectly when the boat was 100 miles distant. The *Philadelphia* is equipped with Marconi apparatus, and the boat was overheard calling up the Babylon station, and later the Sagaponack station. On several occasions the Coney Island De Forest operators have listened to the Sagaponack station calls, over a distance of 80 miles. The remarkable part of this reception is that no transformer, "jigger" or tuning device whatever was used at the Coney Island station, merely the simple aerial conductor, consisting of two stranded copper cables 210 feet in height. As far as known, 20 to 35 miles has been the greatest distance recorded for successful transmission without a "jigger" in connection with the receiver, and the fact that these messages were received so successfully without this adjunct speaks well for the extreme sensitiveness and reliability of the De Forest "responder," or anti-coherer.



WIRELESS TELEGRAPH APPARATUS.

While the steamship *Deutschland* is in dock at Hoboken daily communication is maintained with the De Forest station on the roof of the Chesebrough Building, No. 17 State Street, New York City, notwithstanding the miles of metal warehouses, steel-frame buildings and shipping lying between. This was not, however, possible until the De Forest "responder" replaced the regular coherer on the *Deutschland* station.

The Providence *Journal* has decided to establish wireless telegraph communication between Block Island and Newport. The cable connecting the island has worked very unsatisfactorily for a long time, and the *Journal* estimates that, as a news-getting agency, as well as a commercial carrier, and as affording an excellent shore station for communication with passing vessels, the Block Island wireless plant will be a good investment. De Forest wireless apparatus will be employed throughout. As there is no electric power at either point, the alternating current required by the De Forest transmitter will be generated by a 2½-hp Secor kerosene engine at each station, driving a special 60-cycle generator. The outfits are identical, in fact, with those which the United States Signal Corps used so successfully during the war manœuvres last fall.

The fishing steamer "J. S. Warden," which leaves this port for deep-sea fishing, now carries a De Forest wireless telegraph outfit, and the fishermen are kept in constant touch with the Coney Island station. As New York business men frequently take a day's outing on board, it has become the custom to send out stock quotations, keeping those interested in touch with the market. This has been found to be an attractive feature. The Government stations at Fort Wadsworth, S. I., and Fort Hancock, Sandy Hook, have been completed and turned over to the United States Signal Corps by the De Forest Company. Colonel H. C. Dunwoody, Chief Signal Officer, Department of the East, who has felt a keen interest in the plan to replace the faulty cable between the forts, and who was largely instrumental in bringing about this improvement, has charge of the two wireless telegraph stations.

New Desk Telephone Bracket.

A neat and convenient form of desk telephone bracket has been put upon the market by the De Veau Telephone Manufacturing Company, of 27 Rose Street, New York City. It is made to fit on desks as shown in the cut, or so that it may be attached to the under side of the projecting desk board. It is furnished either in oxidized copper or in full polished nickel. It is so arranged that it will adjust to any size desk base and hold it firmly, owing to the bracket having adjusting screws. After the desk set is placed in the holder and tightened up, there is a thumb screw that takes up all play and holds the desk set firmly. All three lugs are adjustable. The bracket also permits

TELEPHONE BRACKET ATTACHED TO DESK.

of the desk set being swung completely around against the side of the desk. When the desk set is not in use it has a decided advantage, of not taking up any desk room and being entirely out of the way.

The bracket is formed of two separate arms, insuring great strength. The hinge base is made very wide, insuring a long bearing for the pin. This bracket will absolutely not work loose, rattle or shake. It is not made of malleable iron, so that it will not break, but on the contrary is very tough. It is fitted with cord eyelets which prevent the cord from getting twisted or tangled up.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Towards the close of the week time money was decidedly easier, being offered on Friday as low as 5½ per cent for six months. The rates are 6 per cent for sixty to ninety days, and 5½ a 6 per cent for four, five and six months. The stock market was stronger and fairly active, speculative sentiment being much relieved by the announcement that in case of stringency in money the New York banks would furnish a pool of $50,000,000. The announcement that the United States Steel Corporation had acquired the Union Steel Company—a very valuable property—accounts, in part, for the considerable improvement in the steel stocks. Amalgamated Copper was rather quiet, although in common with most of the other industrials, it shared to a certain extent in the stock market's advance. Tractions were also favorably affected, and all closed with substantial net gains. Brooklyn Rapid Transit closed at 64½, after falling to 59¾—a net gain of 2¾ points. Metropolitan Street Railway made a net gain of 2¾ points, closing at 139¾ ,which was ½ point below the highest quotation of the week. Manhattan made a gain of 2⅜ points, closing at 146⅜. The electrics, with the single exception of Westinghouse, closed on the upward turn, General Electric making a net gain of 3¾ points, closing at 176 ex-div. Westinghouse common closed at 193, which is a net loss of 3 points, and Western Union at 87⅝, a net gain of ⅞ point. There was a good amount of trading in all the electrics and tractions. American District Telegraph closed at 36½, being 2 points below the last quotation. Folowing are the closing quotations of December 22:

NEW YORK.

	Dec. 16.	Dec. 22		Dec. 16.	Dec. 22
American Tel. & Cable	89	87	General Electric	174	178
American Tel. & Tel.	157	162¼	Hudson River Tel.	..	..
American Dist. Tel.	34	36	Metropolitan St. Ry.	136⅜	140¼
Brooklyn Rapid Transit	61⅛	65⅜	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	162	160
Electric Boat	20	20	N. Y. E. V. T. Co.	9	9⅝
Electric Boat pfd.	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	3	Western Union Tel.	87⅝	88⅛
Electric Vehicle	4	3½	Westinghouse com.	188	194½
Electric Vehicle pfd.	10	9	Westinghouse pfd.	..	202

BOSTON.

	Dec. 16.	Dec 22		Dec. 16.	Dec. 22
American Tel. & Tel	159½	163	Western Tel. & Tel. pfd.	98	99½
Cumberland Telephone	..	125¾	Mexican Telephone	1⅞	2
Edison Elec. Illum.	..	..	New England Telephone	135½	137½
General Electric	..	175	Westinghouse	93	96
Western Tel. & Tel.	..	23	Westinghouse pfd.	93	98

PHILADELPHIA.

	Dec. 16.	Dec. 22		Dec. 16.	Dec. 2
American Railways	..	..	Phila. Traction	97	97½
Elec. Storage Battery	..	84	Phila. Electric	..	7 8⅜
Elec. Storage Battery pfd.	..	82	Pa. Electric Vehicle	..	..
Elec. Co. of America.	9⅛	9¼	Pa. Electric Vehicle pfd.	..	..

CHICAGO.

	Dec. 16.	Dec. 22		Dec. 16.	Dec. 22
Central Union Tel.	..	..	National Carbon pfd.	98	97
Chicago Edison	175	..	Northwest Elev. com.	..	..
Chicago City Ry.	..	208	Union Traction	..	14
Chicago Tel. Co.	..	..	Union Traction pfd.	..	43
National Carbon	..	26			

BOSTON INTEREST IN TELEPHONY.—With regard to the continuing interest of Boston in the telephone industry, the Boston News Bureau says: Boston National banks and Boston trust companies were never stronger than to-day, their loans were never before in so impregnable a situation, their deposits never so well protected. Boston may not have expanded as have New York, Pittsburg, Cleveland and Canada the past five years, but she has solidified in a most unprecedented manner. She has kept her Bell Telephone and her Calumet & Hecla shares as assured banks of wealth for years to come. She has sold her Montana to the Amalgamated at $500 per share, she has sold her Chicago, Burlington & Quincy at $200 for the strongest mortgage upon the northwestern prosperity she should get, she has recovered millions by the rise of Atchison and exchanged her common shares for preferred and bonds. New England has parted with the management of Union Pacific, which its capital and enterprise originally constructed, but she has still very many millions to show from Union Pacific investments. She has likewise recovered many millions more in General Electric, Westinghouse and other electrical enterprises. She has sold her Boston & Albany for a practical guarantee at the highest price and at increased returns over previous dividends. She has accepted guarantees upon her Old Colony, her Providence and her Fitchburg Railroad shares, garnered millions from Alton and from her Northwestern Railroad shares; has sold her Canadian coal and iron interests at profitable prices to her aspiring northern neighbor, solidified her electric railway systems in and around Boston and now rests financially with only two problems to solve, the solidification of her local gas interests and the developments of the telephone field of the country. The latter should be field enough for the investment of one city, and no other city can show in its possession an investment field the equal of the telephone, for solid and sure, although moderate, returns. New England may well sell her railroad, her electrical and her coal interests at the present high prices and keep the telephone field as capable of almost limitless scientific expansion.

CONSOL. LAKE SUPERIOR CO. appears to have been in some unexplained trouble which caused a heavy decline in its stock last week in Philadelphia, with the result of deferring the regularly declared dividend of 1¾ per cent., and the floating of a loan of nearly $2,0000,000, in large part through Speyer & Co. and the Morton Trust Company, of New York. The company is the result of the merger in 1901 of the American Lake Superior Company and the Ontario Lake Superior Company. Its authorized capital is $82,000,000 common and $35,000,000 preferred 7 per cent. stocks. Of the common $67,000,000 is outstanding and of the preferred $27,000,000. The company owns the Lake Superior Power Company, which operates a 20,000 hp. plant at Sault Ste. Marie, Ont., and the Michigan Lake Superior Power Company, operating a 60,000 hp. power plant at Sault Ste. Marie, Mich., noted in these pages recently. It also owns the following additional properties: The "Gertrude" nickel mines, in the Sudbury nickel range, Canada, from which a nickel steel is made that is taken, up to 250 tons daily, by the Krupp Gun Works, under a five-year contract; the "Helen" iron mine, in which are said to be 30,000,000 tons of iron; a contract with the Province of Ontario, by which the company became the owner of a grant of timber equivalent to 1,000 square miles of virgin forests; the Tagona Water and Light Company, supplying water and light to the town of Sault Ste. Marie, Ont.; the Algoma Central Railway Company, the Algoma Central Steamship Company, the Algoma Central Telegraph lines, the Algoma Commercial Company, and the big Algoma steel plant. So far as can be seen, the company has excellent assets and good prospects.

NEW JERSEY INTER-STATE ROAD.—The Inter-State Railways Company, with an authorized capitalization of $10,000,000, has obtained a charter from the State of New Jersey. The new company is to merge all the street railways in the State and to operate a fast electric line between New York and Philadelphia. It is also rumored that the Pennsylvania Railroad is behind the company in an effort to prevent its lines being paralleled by an electric line or to control the electric line when it is in operation. Another rumor has it that the Pennsylvania organized the company in connection with its New York tunnel plans. Other rumors connect the company with the operation of the trolley tunnel under the Hudson. None of these can be verified nor can any line be obtained as to the promoters. The incorporators of record are Frank B. Housel, William F. Eidel and George B. Martin.

EVERETT-MOORE TELEPHONE.—It is stated that the end of the year will see the street railway affairs of the Everett-Moore syndicate straightened out, but that their Federal Telephone Company's matter is still unfinanced. The company owes between $3,000,000 and $4,000,000, and has about $7,000,000 par value in stock and bonds in sixteen telephone companies. It is thought that the Federal's equity over and above its debts is about $1,000,000 and can be materially increased by developing subsidiary companies. This company will be financed by a bond issue against the assets of the Federal, the bonds to be taken by the Everett-Moore syndicate and by some of the larger creditors. The syndicate will put between $500,000 and $750,000 in new money in the proposition for the purpose of development work.

MARYLAND TELEPHONE.—Negotiations are said to be pending for the acquisition of the Maryland Telephone Company by the same syndicate which recently purchased the stock of the United Electric Light and Power Company, of Baltimore.

DIVIDENDS.—The Westinghouse Machine Company has announced an increase in the annual dividend rate from 6 to 10 per cent. The Westinghouse Air Brake Company has declared the regular quarterly dividend of 2½ per cent., and an extra one of 3½ per cent., payable January 10. The directors of Hall Signal Company have declared the regular quarterly dividend of 1½ per cent. on the common, payable January 1. United Power & Transportation Company, of Philadelphia, declared a dividend of $1 per share, payable January 20. The directors of Metropolitan Street Railway, of New York, have declared the regular quarterly dividend of 1¾ per cent., payable January 15, from the rent guaranteed by the Interurban Street Railway under the lease. The directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable January 15. The Bell Telephone Company, of Philadelphia, has declared a dividend of 2 per cent., payable January 24, as registered January 17. The directors of the American Telegraph & Telephone Company have declared a regular quarterly dividend of 1½ per cent. and an extra of ¾ per cent. In Philadelphia the directors of the Electric Storage Battery Company have declared the regular quarterly dividend of 1¼ per cent. on the preferred stock and 1¼ per cent on the common stock, payable January 2. The regular quarterly dividend at the rate of 5½ per cent. per annum has been declared by the Cincinnati Street Railway Company. The directors of the North Chicago Street Railroad have declared the regular quarterly dividend of 3 per cent, payable January 15. The directors of the Cincinnati Gas & Electric Company have declared the regular quarterly dividend of 1 per cent.

WESTERN UNION.—The Western Union Telegraph Co. issues the following statement for the quarter ended Dec. 31, the figures for the current year being partly estimated, while those of 1901 are actual:

	1902.	1901.		Changes.
Net revenue	$2,100,000	$1,858,318	Inc.	$241,682
Bond interest	252,550	244,000	Inc.	8,550
Balance	$1,847,450	$1,614,318	Inc.	$233,132
Dividend	1,217,010	1,217,010		.....
Surplus	$630,440	$397,308	Inc.	$233,132
Previous surplus	11,528,617	9,812,557	Inc.	1,716,060
Total surplus	$12,159,057	$10,209,865	Inc.	$1,949,192

The actual returns for the Sept. 30 quarter were: Net revenue, $2,247,174; bond interest, $252,550; balance, $1,994,624; dividends, $1,217,010; surplus, $777,614; previous surplus, $10,751,003; total surplus, $11,528,617. The executive committee has recommended the declaration of the regular quarterly dividend of 1¼ per cent., payable Jan. 15.

CONN. RAILWAY AND LIGHTING.—The Connecticut Railway & Lighting Company reports for the fiscal year ended June 30 as follows: Gross income from railway, $1,113, 778; electric, $279,136; gas, $204,470; total gross income, $1,615,384; operating expenses for railway, $616,723; electric, $188,938, and gas, $130,639; total expenses, $936,301; net earnings, $679,083; taxes and miscellaneous interest, $107,180; net applicable to bond interest, $571,903; interest on funded debt, $426,556; balance, $145,347; less extraordinary expenses incurred in betterments to lines, cars, and plants, $57,534; surplus, $87,813. Secretary and Treasurer Lewis Lillie says that the railway department receipts of the year show an increase of 8.5 per cent. over the corresponding period of the year previous. The proposed extensions planned by the company will make about 27 miles of new track, with turn-outs, for developing new territory, which it is expected will very materially increase the gross receipts and net earnings of the company. The increase in electric sales shows 10.6 per cent. over the previous year. The increase in gas sales shows 16 per cent. over the year ended June 30, 1901. The company is operated under the management of the United Gas Improvement Company, of Philadelphia.

AMERICAN RAILWAYS BONDS.—It is announced from Philadelphia that Messrs. Bioren & Co. and Messrs. E. C. Miller & Co. have exercised their option of purchase of the remaining $700,000 of the American Railways Company convertible 5 per cent gold bonds. These bonds were offered for subscription by them to banks and bankers in the city and elsewhere, which subscriptions, closing on the morning of the 20th inst., very largely exceeded the amount of the bonds offered. In view of the existing conditions in the money market, the ease with which these bonds were placed is surprising. The proceeds of the sale of this loan will pay off the existing indebtedness of the American Railways Company, which was incurred by reason of the construction of the Chicago & Joliet Electric Railway Company. This road is already showing a profitable return upon its construction cost.

CHICAGO STREET RAILWAY MERGER.—It is reported that a new move by the street companies of Chicago is proposed to avoid the renewal of their franchises and to overcome the twenty-year limitation. The idea is said to be to bring about a merger of all the street railway lines of the city by lease or otherwise, and operate them under the protecting privileges of the Chicago General Railway Company's charter, which still has forty years to run. This plan was brought to light in connection with a legal opinion on the subject by John N. Jewett, an attorney, and one of the best known authorities on railway corporation matters. Other lawyers of high standing are said to have coincided with the opinion of Mr. Jewett that renewal of the franchises was not absolutely necessary.

TROLLEY RECEIVERSHIP.—At Kingston, N. Y., on December 20, on the application of Assemblyman John Hill Morgan, of Brooklyn, Justice Betts, in the Supreme Court, appointed Joseph A. Duffy, of New York City, receiver for the New Paltz and Poughkeepsie Traction Company, in an action brought against it by the Franklin Trust Company, of Brooklyn, to foreclose a mortgage. The receiver's bond was fixed at $40,000. The traction company operates an electric road which crosses the Poughkeepsie Bridge.

FORECLOSE ON DETROIT TELEPHONE COMPANY.—The Central Trust Company, of New York, which holds a trust mortgage on the property of the Detroit Telephone Company, to secure an issue of $600,000 worth of bonds issued by the telephone company on June 23, 1896, has, according to a dispatch from Detroit, filed a bill in chancery in the United States Circuit Court seeking to foreclose the mortgage, alleging default of interest. The Detroit company is alleged to be insolvent.

PROVIDENCE (R. I.) LIGHTING.—The consolidation of the Providence Gas Company and the Narragansett Electric Light Company by the Rhode Island Company, controlled by the Widener-Elkins syndicate, of Philadelphia, is reported still under consideration. Nearly $5,000,000 is involvd. The syndicate now controls nearly all the traction companies within sixteen miles of Providence.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade received by the mercantile agencies are of highly favorable character. Wholesale trade seems to be taking on a quieter aspect as the stock-taking season approaches. In retail lines, it is noted that holiday-buying is for a rather more expensive grade of goods than ordinarily experienced. "There are, of course," says *Bradstreet's*, "some drawbacks, such as unsettled weather or bad roads at the South, the coal shortage at the East, and the continuance of the railway congestion at the West, affecting the movement of coke, bituminous coal, and general freight, but, taken as a whole, the mercantile community contemplates the approach of the end of the year with complacency and satisfaction." Railway earnings thus far reported for December exceed last year's by 4.2 per cent, and those of 1900 by 10.4 per cent. The iron trade presents a quiet surface, but some important changes are taking place. "The passing of control of large independent mills into the hands of the Morgan interest unquestionably makes for stability in the department of wire, tinplate and sheets," says *Bradstreet's*. Very heavy buying of cars and other rolling stock for the new year is in evidence, and liberal orders for plates, wires and structural materials for 1903 delivery are also noted. Practically the entire rail output of the country for next year is already sold, and new business and urgent buyers are compelled to go abroad. In copper there was an effort to create the impression that prices had advanced, but actual conditions do not warrant the acknowledgment that such was the fact. Lake is quoted on the Metal Exchange at 11.65c.; electrolytic and casting stock, 11.45c., and Standard, 10.75c. There was practically no business transacted on the New York Exchange. The business failures for the week ending December 18, as reported by *Bradstreet's*, aggregated 225, as against 236 the week previous, and 262 the corresponding week last year.

LONG ISLAND FIRE ALARMS.—The criticism which the Queens County Grand Jury passed upon Fire Commissioner Sturgis last June, after the disastrous fire at Rockaway Beach, has stirred him to action and he is pushing along the fire alarm system in the borough of Queens with rapidity. Thirty-five boxes will be installed in the Woodhaven district at once and a like number in Ozone Park and Aqueduct. Though $47,000 had been appropriated for the purpose, the Fire Department made no effort to equip the borough with a fire alarm telegraph system until the Grand Jury took up the matter.

EXPORT TRADE FIGURES.—The foreign trade statement for November might be better in that it shows a falling off from, rather than a gain over October figures. Exports of breadstuffs, provisions, cotton and oil, were but $70,726,543 in November, against $84,926,618 in October. The result is that November's excess of exports of $39,564,416 is the smallest for the month since 1894. November exports of $125,043,181 compare with $144,327,428 in October, and a monthly average for the year up to November of $108,748,890. For the three months of summer the average was but $90,991,140, so that November exports, even if much below October's, are still not without encouragement. Imports continue notably heavy, the November figure of $85,478,765 having been but twice exceeded, and that slightly, in the past five years. For the past three months the average is $86,878,083, against an average of but $65,184,558 in the last quarter of 1900, the period when exports reached their largest totals on record. The course of the balance of trade in 1902 may be briefly indicated by the following table of excesses of exports:

January	$50,006,988	October.....	$55,692,290
July	9,643,753	November.....	39,564,416

ELWELL-PARKER MOTORS FOR BREWERY.—The Elwell-Parker Electric Company, of Cleveland, Ohio, through the Northern Engineering Company, has just been awarded a contract for two generators and several motors intended to be installed for light and power purposes in Ebhling's brewery, 156th Street and Amsterdam Avenue, New York City. The equipment will consist of two generators, each of 62½ kw, 275 r. p. m. They will be direct connected to 13-inch by 12-inch tandem compound engines, to be supplied by the Buffalo Forge Company, whose New York address is 39-41 Cortlandt Street. The motors will be ten in number, aggregating in all 97 hp. There will be one of 20 hp, 650 r. p. m.; one of 15 hp, 675 r. p. m.; four of 10 hp, 750 r. p. m.; two of 7½ hp, 825 r. p. m.; one of 5 hp, 1,500 r. p. m., and one of 2 hp, 1,700 r. p. m. The Elwell-Parker Company will also furnish one 60-kw, 275-r. p. m. dynamo for direct connection to a New York Safety engine, and a 40-kw, 275-r. p. m. dynamo to be coupled to New York Safety engine for the Ivy Courts Realty Company, 210 West 107th Street, New York City. This outfit will be used for lighting purposes.

HAINES & NOYES COMPANY.—Announcement is made that the Haines & Noyes Company, of Chicago, has become affiliated with the Couch & Seeley Company, telephone manufacturer, Boston, Mass. The Haines & Noyes Company will in the future be the Western department of Couch & Seeley, with offices in Chicago. All prices will be f.o.b. Chicago for Western selling, and a large stock will be carried in that city. The Couch & Seeley Company is the largest and oldest independent telephone manufacturing company in the East, and its apparatus is too well known to comment upon. The Haines & Noyes Company has been in existence but a little over two years, but it has built up a large business and has become well known throughout the telephone trade. All communications or orders from the West, including the Western part of Canada and Mexico, will be directed to the Haines & Noyes Company, Western department of the Couch & Seeley Company, 153-157 South Jefferson Street, Chicago, while all communications and orders in the East should be directed to the Couch & Seeley Company, Boston, Mass. This affiliation should prove a strong and important factor in the independent telephone field.

MEAD MACHINERY FOR WESTERN PLANTS.—John A. Mead & Co., of Rutland, Vt., whose New York offices are in the Bowling Green Building, have taken a second contract for the installation of coal and ash handling machinery in the South Chicago plant of the Commonwealth Electric Company, of Chicago, for which concern Sargent & Lundy, of Chicago, act as consulting engineers. The contract calls for two equipments, each capable of handling 70 tons an hour. This machinery is to be used in connection with the second and third units, which the Commonwealth people are about to put in. The plant before completion will have fourteen units in all. The Mead Company has also taken a contract from the Cincinnati Gas and Electric Company, which is considerably adding to its equipment for coal and ash handling machinery to take care of 45 tons of material hourly. The additional boiler equipment has been ordered from the Sterling Company. Sargent & Lundy are the consulting experts also for the Cincinnati plant.

ST. LOUIS CONTRACTS AWARDED.—At a special meeting of the committee on the president's department of the Board of Public Improvements, held last week, contracts were awarded for the installation of electric lighting plants at the City Hall and Insane Asylum. The Westinghouse Electric & Manufacturing Company got the contract for the lighting apparatus at the City Hall and the Chuse Engine Manufacturing Company got the contract for the engines at the City Hall. Their bids were $12,750 and $13,453, respectively. The contract for the conduits at the City Hall was awarded to the Abbott-Gamble Construction Company, whose bid was $4,900. The contract for the electrical apparatus to be used at the Insane Asylum was awarded to the Frank Adams Electrical Company, whose bid was $5,689, and the contract for the engines at the same place was awarded to Brownell & Co., of Dayton, Ohio, whose bid on that work was $3,330.40.

SOME BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, through its New York manager, Mr. Paul Bigelow, has secured within the past few days a number of substantial contracts for engines to be used in lighting, power and general industrial plants throughout the country. The Binghamton (N. Y.) Light, Heat & Power Company has ordered a Buckeye simple engine for direct connection to a 350-kw General Electric generator. This outfit will be utilized for lighting purposes. The E. M. Brown Paper Company, of Rock City Falls, N. Y., has requisitioned for a 125-hp simple engine to be belted to a generator for lighting use. A similar engine to be used for a like purpose has been ordered by Bernhard Meiners, Erie Basin, Brooklyn, N. Y. The Danbury & Bethel Power Company, of Danbury, Conn., has called for a 300-hp Buckeye cross compound engine for direct connection for power purposes, to a generator of 200 kw capacity.

BALL ENGINE ORDERS.—The McPherson Water & Electric Works, of McPherson, Kan., have recently purchased from the Ball Engine Company, Erie, Pa., a 125-hp engine arranged for direct connection to two General Electric generators. The United States Coal Company, Dillonvale, Ohio, is installing two 300-hp Ball engines, which are to be used for electric mining. The Osgood Light Company, Osgood, Ind., has recently placed in operation one 125-hp direct-connected engine furnished by the Ball Engine Company. The American Car Company, St. Louis, Mo., has recently placed in operation a 100-hp direct-connected unit. The Ball Engine Company furnished the engine. The Arkansas & Texas Consolidated Ice & Coal Company, Marshall, Texas, has recently purchased a 200-hp Ball engine for electrical purposes.

THE UNION RAILWAY COMPANY, of New York City, is about to build a large sub-station at West Farms, for which it has purchased from the Westinghouse Electric & Manufacturing Company a large amount of apparatus, including three 1,000-kw, three-phase rotary converters, with starting motors, self-cooling, oil-insulated transformers and alternating-current and direct-current switchboards. The transmission will be at 6,300 volts and 3,000 alternations. The alternating-current switchboard will be equipped with the new Westinghouse oil-break, electrically-operated switches. The Bayard Street station of the Metropolitan Street Railway Company, of New York City, is also being equipped with these switches.

SOME PASS & SEYMOUR EXPORT ORDERS.—Pass & Seymour, of Solvay, N. Y., through its New York manager, Mr. W. Brewster Hull, has recently succeeded in securing several fair-sized contracts for its specialties to be shipped to various foreign countries. An order has been obtained through the Markt & Struller Company, 193-4 West Street, New York City, for a considerable number of fusible and fuseless rosettes for shipment to Mexico. The Western Electric Company has sent in a large order for sockets and rosettes to go to Australia. Among large domestic orders received within the last few days is one for several big transformer cut-outs to be shipped to the Kuhlmann Electric Company.

CLEVELAND ELECTRIC PLANT BEING EXTENDED.—The Cleveland Electric Illuminating Company, of Cleveland, Ohio, is letting contracts for a large extension to its plant. The orders are being placed through Mr. Robert Grindsley, the general superintendent. John A. Mead & Co., of 11 Broadway, New York, have been alotted a contract for coal and ash machinery capable of handling 70 tons an hour.

TROLLEY FOR PORTUGUESE AFRICA.—A cable dispatch from London says: "Macartney, McElroy & Co., of London, have obtained a contract for the construction of electric tramways at Lorenzo Marques, Portuguese East Africa. The value of the contract is $500,000." It is understood that American apparatus is to be supplied.

CONTRACT PENDING FOR CUBAN ELECTRIC PLANT.—H. J. Reilly, the consulting engineer of Trinity Place, New York City, will shortly call for estimates for a 300-hp plant, which is to be erected in Caniajuanti, for the purpose of lighting that Cuban town.

AFTER BIG JAPANESE CONTRACTS.—The American Trading Company, Broad Exchange Building, Broad Street, is figuring on some important contracts for the equipment of Japanese street railway and lighting systems.

STUART-HOWLAND COMPANY, Boston, has recently taken the exclusive New England agency for the line of electric lighting specialties manufactured by the Geo. Cutter Company, Chicago.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended December 13: Argentine Republic—99 pkgs. material, $3,091; 33 pkgs. machinery, $1,305. Brussels—1 pkg. material, $5. Brazil—51 pkgs. material, $1,173; 4 pkgs. machinery, $326. Bremen—1 pkg. material, $69. British East Indies—12 pkgs. material, $751. Berlin—2 pkgs. machinery, $130; 1 pkg. material, $150. British Possessions in Africa—56 pkgs. machinery, $6,021; 2 pkgs. material, $74. British Guiana—42 pkgs. material, $786. Birkenhead—295 pkgs. material, $900. British West Indies—8 pkgs. material, $167. Copenhagen—1 pkg. machinery, $162; 200 pkgs. material, $150. Central America—78 pkgs. material, $702; 11 pkgs. machinery, $1,277. Cuba—41 pkgs. material, $687. Dutch West Indies—8 pkgs. material, $142. Genoa—1 pkg. machinery, $50; 16 pkgs. material, $400. Glasgow—36 pkgs. material, $1,518; 41 pkgs. machinery, $9,950. Hong Kong—9 pkgs. material, $132. Hamburg—16 pkgs. machinery, $1,662; 277 pkgs. machinery, $8,812; 104 pkgs. material, $10,939. Havre—19 pkgs. material, $567; 3 pkgs. machinery, $610. Japan—106 pkgs. material, $9,724; 29 pkgs. machinery, $4,914. London—150 pkgs. machinery, $3,770; 102 pkgs. material, $6,906. Liverpool—223 pkgs. machinery, $15,977; 91 pkgs. material, $4,336. Leicester—1 pkg. machinery. $227. Mexico—11 pkgs. material, $149. Manchester—49 pkgs. machinery, $3,434; 2 pkgs. materiala, $450. Newfoundland—2 pkgs. material, $75. Nova Scotia—15 pkgs. material, $192; 2 pkgs. machinery, $112. Philippine Islands—2 pkgs. material, $291. Rotterdam—3 pkgs. machinery, $784. Southampton—6 pkgs. material, $255. Stockholm—1 pkg. material, $55. San Domingo—22 pkgs. material, $403. Uruguay—18 pkgs. material, $304. U. S. Colombia—24 pkgs. material, $876. Venezuela—2 pkgs. material, $68.

NEW METHOD OF TREATING COPPER ORES.—A process is claimed to have been perfected for the treating of copper and other sulphite ores, which, according to experts, will bring about almost as great a revolution in the art of metallurgy as did the invention of Bessemer in the manufacture of steel. It will permit of the opening up of hundreds of low-grade copper mines throughout the country, which are now lying dormant because of the hitherto prohibitive cost of operation. The new method is the invention of former Superintendent Knox, of the East Pittsburg Gas Company, controlled by Mr. George Westinghouse. Mr. Knox has been working on the system for some years past at the instance of Mr. Westinghouse, who has already, it is said, invested over $2,000,000 in the process and in the acquisition of low-grade mines in New England and along the Soo. The Knox process does away with the preliminary roasting of the ores, which not only is an expensive treatment, but one which kills all vegetation within seven or eight miles of the smelters. Patent papers taken out describe the invention as a method for separating copper from copper matte, in which the iron and other metals exist largely as sulphides, which consists in melting the matte oxidizing iron and sulphur of the matte by forcing air into contact therewith while in a molten state, thereby generating heat sufficient to maintain the mass in a molten state, causing the formation of iron oxysulphides under such conditions that substantially no silicate of iron is formed and in separating the copper therefrom by causing it to remain quiescent a sufficient time to separate by gravity. Extensive operations are now being conducted under the supervision of Mr. Knox at Copper Fields, Vermont. The concentrates are being shipped to the Westinghouse Works.

SOME A. D. GRANGER COMPANY ORDERS.—The A. D. Granger Company, White Building, 95 Liberty Street, has been awarded a contract for three 11-inch by 12-inch horizontal automatic Skinner engines for direct connection to 50-kw Crocker-Wheeler generators, which are to be installed in Church, Dodge & Co.'s new office building at Troy, N. Y. The Granger Company has also taken an order for a 16-inch by 18-inch Woodbury horizontal automatic engine for direct connection to a 100-kw General Electric generator, and for a 14½-inch by 16-inch Woodbury horizontal automatic engine for direct connection to a 75-kw General Electric generator. These machines are to serve for light and power purposes in the Y. M. C. A. building, Twenty-third Street, New York City. The Hebrew Orphan Asylum, at 138th Street and Amsterdam Avenue, New York City, is to be installed with two horizontal automatic Skinner engines, one 12-inch by 15-inch, and the other a 14½-inch by 15-inch one, direct connected to 50-kw and 75-kw General Electric generators, respectively. This outfit will be used for lighting purposes. A Woodbury engine, 8 inches by 12 inches, has been ordered for direct connection to an Elwell-Parker generator, of 25 kw capacity, for light and power use in the plant of Scheuer & Co., Paterson, N. J.

EQUIPMENT FOR N. J. SILK FACTORY.—The North American Silk Company, of West New York, N. J., has just placed contracts for equipment which will be employed to furnish electric light and to operate looms and other machinery. A 37½-kw generator, 325 r.p.m., direct-connected to a 7-in. by 3½-in. by 10-in. tandem compound engine will be installed. The generator will be built by the Elwell-Parker Electric Company, of Cleveland, Ohio, and the engine will be furnished by the Buffalo Forge Company. There will also be three Elwell-Parker motors of 7½ hp each, 825 r.p.m., and one 5-hp motor, 900 r.p.m.

STEAM AND ELECTRICAL EQUIPMENT COMPANY, of Conestoga Building, Pittsburg, report the sale recently of a 300-kw street railway generator direct connected to a 16 by 30 by 42 Wetherill tandem Corliss engine, one 24 by 42 Corliss engine of 300 hp and one 72 by 16 steam boiler, Russell make. The company are now representing the Cosmopolitan steam condenser, with which they state engines are being operated condensing with less consumption of water even than was needed to run engines, high pressure. They have some special literature on the subject.

SOME ROTH MOTOR ORDERS.—Roth Bros. & Co., of Chicago, and 95-97 Liberty Street, New York, have secured a contract for seven motors to be installed for general power purposes in the silk mills at Paterson, N. J., of the Benjamin Eastwood Company. There will be one 10-hp, 800 r.p.m., two 7½-hp, 1,250 r.p.m., two 5-hp, 1,550 r.p.m., and two 2-hp, 1,650-r.p.m. machines. An order has also been received from the General Manifold Company, of Franklin, Pa., for one 10-hp, 800 r.p.m., two 5-hp, 900 r.p.m., and four 2-hp, 1,100-r.p.m. motors to be used for power.

CARS FOR THE RAPID TRANSIT SUBWAY.—Important contracts for cars for the New York Rapid Transit Subway road were awarded last week. Five hundred cars have been ordered and contracts for 300 more will be determined on shortly. The St. Louis Car Company got a contract for 200, and the Wason Manufacturing Company, of Springfield, Mass.; the Jewett Car Company, of Newark, Ohio, and the John Stephenson Company, of Elizabeth, N. J., were allotted contracts for the building of 100 cars each.

GASOLINE ENGINE LIGHTING PLANT.—The Northern Engineering Company has secured a contract for a gasoline engine and dynamo outfit, with switchboard, etc., complete, to be installed for lighting in the residence of Mrs. G. A. Hobart, widow of the late Vice-President Hobart, at Paterson, N. J. The plant will have a capacity for 100 lights. The engine and dynamo will be built by the Merriam Abbott Company, of Cleveland, Ohio.

THE NEW YORK CENTRAL RAILROAD has made a contract with the General Electric Company and with Westinghouse, Church, Kerr & Co. for the installation of steam engines and alternating current generators for the Weehawken Station on the west shore of the Hudson River, opposite New York. The company is expending some $50,000 on its electric plant there.

RAILS AND TIES FOR THE SUBWAY.—The Cambria Steel Company, of Johnstown, Pa., has taken a contract for 3,750 tons of contact rails for the New York Subway. One hundred and twenty thousand ties have been ordered from Robert R. Sizer & Co., Coffee Exchange Building, New York City.

ELECTRO-PNEUMATIC CONTROL.—A Pittsburg dispatch states that the Brooklyn Elevated Railway has awarded a contract to the Westinghouse Electric & Manufacturing Company to equip all the new cars with the Westinghouse electro-pneumatic multiple unit control.

ST. JOSEPH RIVER POWER.—Mr. C. R. Chapin, of Chicago, has secured a legal decision in favor of his rights over power from the St. Joseph River, against contestants from Berrien Springs. Mr. Chapin has already spent large sums on the development at Berrien Springs, and proposes to push matters.

NEW SUBMARINE BOATS.—Among the bills introduced in the United States Senate last week was the following: By Senator Platt (Conn.), authorizing the construction of submarine torpedo boats, cost not to exceed $1,000,000.

SUPPLIES FOR JAPAN.—H. Becker & Co., Curtis Building, South William Street, New York, has secured a large order for electrical supplies for the Tokio Street Railway Company. The General Electric Company will fill the order.

WESTINGHOUSE MICA PLANT.—The Westinghouse Electric and Manufacturing Company will, it is stated, open a plant near Detroit, Mich., for the purpose of preparing mica for use in making electrical machinery.

PITTSBURG LAMP DEAL.—The entire plant and business of the Pittsburg Incandescent Lamp Company, Pittsburg, has been purchased by the Pittsburg Electric Lamp of Company, of Braddock, Pa.

General News.

THE TELEPHONE.

TAMPA, FLA.—The Tampa telephone system, just completed, has 2,000 instruments in operation and 300 miles of wire. It includes the Tampa exchange and branches at Barton, Lakeland, Plant City, Bradentown and Palmetto.

MILLEN, GA.—The Southern Bell Telephone Company will erect a new exchange here.

QUINCY, ILL.—The Western Illinois Telephone Company has applied for a franchise in this place.

PONTIAC, ILL.—The Friendship Telephone Company will build a telephone line from Graymont to Flanagan.

DAMASCUS, ILL.—A telephone line from this place to Lena is projected. Mr. Lowry, of Pearl City, is interested.

DESPLAINES, ILL.—The F. E. Bell Telephone Company has changed its names to Desplaines Telephone Company.

SIBLEY, ILL.—The Sibley Telephone Company has been incorporated with a capital of $4,000, by W. R. Hamilton, A. A. Absher and F. A. Warner.

GREENVILLE, ILL.—The Mutual Telephone Company, of Montgomery County, has been granted a franchise by the board of supervisors to build its line in the county.

KANKAKEE, ILL.—The council has granted a 25-year franchise to the Interstate Independent Telephone and Telegraph Company, a branch of the Illinois Telephone Company.

CHICAGO, ILL.—The Illinois Telephone and Telegraph Company has applied to the Commissioner of Public Works for a permit to extend its conduits through a large section of the West Side, which, by its ordinance, it is permitted to do.

INDIANAPOLIS, IND.—The Nine-Mile Telephone Association, of Allen County, has incorporated with a capital stock of $10,000. The incorporators are F. T. Kenick, George Cloandale, of Ft. Wayne; T. P. Harbor, of Sheldon and J. R. King, of Nine-Mile.

BORDEN, IND.—The Daisy Telephone Company of Borden, Clark County, has been incorporated, with $2,000 capital stock. Among the incorporators are: William H. Porter, W. E. Gray, Daniel M. Gray, Charles F. Gray, Benjamin F. Stalker, William Stone and William Rosenberger, all of Borden.

KOKOMO, IND.—The Bell Telephone Company in its fight against the local independent concern has reduced residence rates to 50 cents a month. The home company promises to meet the cut and may offer a 25-cent rate. When the Bell Company had a monopoly of the business here the residence rate was $2.

INDIANAPOLIS, IND.—The proposition to debar from membership in the Interstate Independent Telephone Association all companies granting concessions or accepting favors from the Bell Telephone Company is not meeting with favor from a number of Indiana cities. These cities want but one system and want that system open to connection with all outside exchanges, whether conducted by the Bell or independent companies.

EVANSVILLE, IND.—The Cumberland Telephone Company has filed suit in the Federal Court at Indianapolis asking for an injunction against the city to prevent it from destroying the property of the company. The company's franchise has expired and the authorities have ordered the company to remove its poles and wires, and cease doing business in the city.

INDIANAPOLIS, IND.—The Board of Safety is advertising for bids for telephone service in the police and fire departments for 1903 and the rivalry between the two local companies is quite spirited. The contract amounts to considerably over a thousand dollars and the bids are usually very low. In some of the city offices both telephones are used, but the fire department houses have connection with only one line. The new company had the contract last year.

MUNCIE, IND.—The Anderson and Elwood exchanges of the Delaware and Madison County Telephone Company are now in operation and the exchange at Alexandria is ready to open. When the extension is completed Muncie will have communication with the leading cities and towns of Indiana, Ohio and Michigan. The company now has contracts for 1,400 telephones, which are being installed at the rate of 50 a day. The entire system will be in operation by January 1.

REMSEN, IA.—J. H. Quick, of Sioux City, and P. J. Miller have been granted a telephone franchise in this place.

BURLINGTON, IA.—The Burlington and Augusta Telephone Company has been incorporated with a capital of $50,000.

WASHTA, IA.—The Farmers and Merchants' Telephone Company, of Washta, has been incorporated by James Robertson, Jr., A. H. Stivers, Thomas Williamson, U. C. Rogers, H. A. Pinckney, J. H. Duart, M. McGregor and George E. Snidecar. The capital is $10,000.

DES MOINES, IA.—The strike of the operators of the Bell Telephone Company here, which has now been in progress about six months, was settled on Dec. 16 by representatives of the company and of the Trade and Labor assembly. The telephone girls are to be paid wages 15 per cent. in excess of the union scale, and all of the girls who struck are to be taken back to work. The company further agrees not to in any way discriminate against the strikers. The injunction suit to restrain the representatives of union labor from boycotting the company is to be dismissed.

BOWLING GREEN, KY.—The new Independent Telephone Company will erect an exchange in this place.

HAVELOCK, LA.—The business men of this place have organized a telephone company.

HART, MICH.—The local telephone company, which is operated in Oceana and Muskegon counties, is making extensive improvements. To-day telephones are in a great many farmhouses, whereas two years ago not a farmer had any communication with the towns except as he might hitch up his horse and drive to any point.

KANSAS CITY, MO.—The Kansas City Home Telephone Company has bought a lot on Baltimore Avenue and will, in the near future, begin the erection of a handsome and modern telephone building.

ARLINGTON, NEB.—The Arlington Telephone Company has increased its capital stock from $5,000 to $10,000.

TAMORA, NEB.—The farmers of this section have organized a mutual telephone company and will build lines in three directions.

YORK, NEB.—The stockholders of the Consolidated York County Independent Telephone Company have elected the following directors and officials: Captain George Holdeman, president; C. N. Beaver, vice-president; J. M. Bell, treasurer; Edwin Bell, secretary and manager; George Holdeman, Alfred B. Christian, W. L. Kirkpatrick, J. B. Erwine of Waco, Dr. Straight of Benedict, J. M. Bell and C. N. Beaver, directors. The new company starts out with a paid-up capital of $20,000 and has a network of wires over the north and northeast part of the county. It is a consolidation of the York Telephone Company, the Waco Telephone Company and the Benedict Telephone Company.

HOPKINTON, N. H.—The Hopkinton Telephone Co. has decided to extend its line from Contoocook to West Hopkinton.

BASKING RIDGE, N. J.—At Basking Ridge recently a fine for breaking the State game laws was inflicted over the telephone and duly paid to the nearest officer by the culprit.

ROCHESTER, N. Y.—The Rochester Telephone Company is putting in a line which will be equipped with apparatus that will accommodate forty telephones on one line.

ALBANY, N. Y.—The Columbia Telephone Company, of Hudson, has been incorporated, capital $50,000. Directors: Benjamin F. Case, Canton Center, Conn.; J. H. Bidwell, Collinsville, Conn.; E. C. Getty, Hudson.

TROY, N. Y.—The Eastern New York Telephone and Telegraph Company has entered into a five years' contract with the Rensselaer Telephone Company for connection with its toll lines. The connection with Troy and the Rensselaer Company's entire territory will be in operation about Jan. 1.

COOPERSTOWN, N. Y.—A telephone war in earnest is on between the Central New York Bell Company and an independent company. The village is becoming a network of wires overhead and tall poles line both sides of the principal streets. One of the opposing companies has offered to install telephones and give six months' service free to its subscribers. Both companies claim to be gaining ground daily.

DAVENPORT, N. C.—The Providence Telephone Company, a rural exchange, is building lines to Waxhaw, Matthews and other points.

WHITEVILLE, N. C.—The Columbus Telephone Company has increased its capital stock from $10,000 to $20,000. A number of toll lines are operated by this company.

WARSAW, N. C.—H. L. Stevens is president of the Duplin Telephone Company which has begun work on a line from Clinton to Magnolia, N. C., where connection will be made with the Bell Company.

VERMILLION, OHIO.—The new independent telephone exchange at this place is now in operation. It has 139 subscribers.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has fitted up a hospital adjoining its exchange. A trained nurse, Miss Edna L. Tuttle, is in charge.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Telephone Company now has 2,500 telephones in operation and operates six exchanges, including New Philadelphia, Canal Dover and Uhrichsville. The annual meeting will be held in January.

OXFORD, OHIO.—The Oxford Telephone Company has completed a connection with the farmers' line controlled by Ezra Bourne and is now affording service throughout a large district including Bath, Brookville, Mixerville and Springfield. The switchboard is being enlarged for the new service.

FOSTORIA, OHIO.—Farmers in the neighborhood of this city have asked that the lines of the Fostoria Home Telephone Company be extended throughout the district. Estimates are being prepared for an extension of the switchboard to take care of these people. The company is controlled by the Federal Telephone Company.

YORK, PA.—The United Telephone and Telegraph Company is building a new line from Lancaster to Landisville.

SUMTER, S. C.—The Bell Telephone Company is seeking a franchise to establish long distance service here and also a local exchange in October, 1903, when the exclusive franchise of the Sumter Telephone Company expires.

MEMPHIS, TENN.—The East Tennessee Telephone Company is building a line from Memphis to Bowling Green.

ASHLAND CITY, TENN.—It is said that a number of leading business men will soon organize a telephone company and put in a local exchange. The system will be extended to a number of outside cities.

MOUNDSVILLE, W. VA.—The National Telephone Company is building a line between this city and Wheeling.

RACINE, WIS.—The Citizens' Telephone Company, of Racine, has incorporated with a capital stock of $50,000.

WEST SALEM, WIS.—The West Salem Telegraph and Telephone Company has changed its name to La Crosse County Telephone Company and transferred its headquarters to La Crosse.

FOOTVILLE, WIS.—The Footville Telephone Company of the village of Footville, capital stock $4,000, has been incorporated by S. W. Lacey, A. E. Aspinwall, J. Meehan, F. W. Snyder, Walter Honeysett and W. O. Howell.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—After a 30 days' test of the electric current from the water power at Tallassee, on the Tallapoosa River, 35 miles from here, the consolidation of the Montgomery Light and Power Company and the Tallassee Water Power Company has been effected, the new name being the Montgomery Light and Water Power Company. The river can supply 5,000 horse-power, and the local steam plant 3,000. The present consumption is about 2,500. The steam plant here is not operated, but available if the water power fails for any reason.

COLUMBUS, GA.—Engineers are making preliminary surveys at the Clapp factory site near Columbus for developing a fine water power. A dam 54 feet high will be erected to furnish power for an electric railway, electric light, etc.

MASCOUTAH, ILL.—The Mascoutah Light Company will increase its capital stock from $5,000 to $7,500, and will construct a local telephone system, for which a franchise has been granted by the city council.

DAVENPORT, IA.—The Davenport Gas and Electric Company will install a 600-kw. alternator, to be driven by a 1,000-hp. engine; also three Brush 125-arc light machines.

HARRODSBURG, KY.—This city has voted $18,000 electric light bonds.

LAUREL, MD.—The Laurel & Seaford Electric Light Plant Co. has increased its capital from $20,000 to $50,000.

SPRINGFIELD, MASS.—The Montague Electric Street Light and Power Company has been formed, with a capital of $2,000. Electricity will be generated by the water power controlled by T. F. Harrington.

COLUMBIA, MO.—A contract has been awarded by the University to J. W. Wilson, of St. Louis, for the construction of an addition to the University power-house. The recent addition of several new buildings to the University group made this improvement necessary.

CLARENCE, MO.—The proposition to increase the indebtedness of the city $10,000 to erect an electric light plant carried at the election held Dec. 16. This is the fourth time the city has voted upon the proposition. The ordinance provides for the issuance of $10,000 in five twenty-year bonds, at 5 per cent.

SYRACUSE, N. Y.—The Baldwinsville Heat and Light Company has been formed with $100,000 capital, the directors being William F. Morris, Jacob Amos, John T. Wilkins, E. C. Munroe, Windsor Morris and Robert Rose.

GALION, OHIO.—A proposition is before the city council to issue bonds for the repair of the electric light plant, which will amount to between $10,000 and $15,000.

CLEVELAND, OHIO.—The Pennsylvania Railway Company is preparing to erect an electric power plant on its docks at Cleveland. It will operate ore conveyors.

MEDINA, OHIO.—The Medina Electric Light, Power & Heating Company, formed some time ago to take over the plant of the Medina Electric Light Company with a view to enlarging the plant and heating the town, has failed to consummate the deal.

DALLASTOWN, PA.—An electric light plant, to cost $5,000, will be built at Dallastown.

YORK, PA.—The York Haven Power Company has a force of men engaged in stringing its line of wires from the York Haven plant to York, Pa. As the plant will not be in operation for a year, the wire will be kept charged with a 1,000-volt current supplied by the Edison plant. The purpose of charging the wire is to prevent its theft.

LEHI, UTAH.—The Utah Sugar Company is erecting a power plant on the Bear River to cost $150,000, installed in two units of 2,000-hp. each. The first 2,000-hp. has been contracted for to the Utah Light and Power Company, which will build its own line and connect at Ogden. Thomas R. Cutler is general manager.

SNOHOMISH, WASH.—One of the boilers at the city water works, which furnished power for the electric light plant, exploded recently, killing one of the electricians and doing much damage to the apparatus. The city was without electric light and water until repairs could be effected.

BARABOO, WIS.—The Baraboo Gas and Electric Light Company has changed its title to Baraboo Lighting Company.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The United Railroads Company will begin operating the new line to San Mateo early next year. Three sub-stations will be maintained which are to be supplied from high tension lines. Each will be equipped with one 750-kw motor-generator. One corner of the new 16,000-hp power station on Bay Street is under roof, and the first unit of the new plant is being erected. Chas. C. Moore & Co. are installing the Babcock & Wilcox water tube boilers having a combined capacity of 8,000 horse-power with a complete oil-burning system. The first 4,000-hp unit, consisting of two 1250-kw 13,000-volt generators direct-connected to one Union Iron Works engine, may be ready for operation in January.

FLORENCE, COLO.—A franchise has been granted to Thomas Robinson, of this city, to build and operate an electric railway.

CRIPPLE CREEK, COLO.—Deeds conveying right of way to the Cripple Creek and Pueblo Railroad Company have been filed and simultaneously articles of incorporation. The purpose of the corporation is to construct a 33-mile railroad connecting the gold camp with Pueblo. The road will be constructed in the district through a system of underground tunnels, and the motive power used in the tunnels will be either electricity or compressed air. Thomas B. Casey, of Boston, is the president of the company; J. R. McKay, of Chicago, treasurer.

VINCENNES, IND.—The Western Indiana Traction Company, of Vincennes, has filed incorporation papers. The capital stock is $100,000 and Edgar H. DeWolf, of Vincennes, heads the board of directors.

INDIANAPOLIS, IND.—The county commissioners have granted a franchise to the Indianapolis, Lebanon & Franklin Traction Company enabling it to cross highways in the county. The road will be built on private right of way.

INDIANAPOLIS, IND.—The stockholders of the Indianapolis Street Railway Company will, on Dec. 29, vote on a proposition to lease that company's lines to the Indiapapolis Traction & Terminal Company for 30 years. Upon approval of the proposition the stock of the Terminal Company will be increased to $50,000,000.

FT. WAYNE, IND.—The Ft. Wayne Street Railway system and several lines leading out of the city has been purchased by the McCulloch interests. This purchase is said to mean the ultimate consolidation of these properties with the McCulloch interests which already control 450 miles of interurban lines in the State.

MAYSVILLE, KY.—The Bluegrass Traction Company, Maysville, Ky., will probably erect a power house at either Lexington or Paris. The company is to construct a trolley line 23 miles in length from Maysville to several surrounding towns. John Duley, president of the Board of Trade, is interested.

LAWRENCE, MASS.—The Lawrence and Methuen Street Railway Company has purchased a large lot of land at Methuen and will build a new power house.

MIDDLEBORO, MASS.—The extension of the Middleboro, Wareham & Buzzard's Bay Street Railway through to Sandwich is assured. The Selectmen of that town have granted the company's petition in preference to that of the local company, the Cape Cod Street Railway. An extension of the Sandwich line is contemplated later to the Vineyard Sound shore at Cotuit, thence to Hyannis, Dennis, Harwich and Chatham.

ALBION, MICH.—The Jackson-Battle Creek Traction Company will erect large car barns and repair shop in this city.

CAMDEN, N. J.—The Monterey Electric Railway Company has been incorporated here; capital, $1,500,000; incorporators, Leroy W. Sperry, Baltimore, Md.; Edward F. Mass and Simon J. Block.

JERSEY CITY, N. J.—The Puget Sound Electric Railway has been incorporated by Preston Player, Nathan H. Daniels, Jr., Howard L. Rogers, Henry Reed Hayes, George C. England, Waldo E. Forbes, Alvah K. Todd and Gardner Rogers, of Boston, and Louis B. Dailey, of Jersey City.

NEW YORK, N. Y.—The State Railroad Commission has authorized the Union Railway Company of New York to use the overhead trolley system in extensions of its lines on several streets in the Borough of the Bronx.

ROCHESTER, N. Y.—The Penn Yan, Keuka Park and Branchport Electric Railway Company has been compelled to suspend operations, owing to its inability to secure a supply of coal. This is the second time this road has shut down from this cause.

NEW YORK, N. Y.—It is reported that the Manhattan Railway Company has leased, or is about to lease the Yonkers line of the Putnam division of the New York Central Railway. According to the report the line is to be equipped with the third rail system and express trains are to be run through from the South Ferry, Manhattan, to Getty Square, Yonkers.

COLUMBUS, OHIO.—The interurban railway people are planning to build a belt line around Columbus for use of both steam and electric roads entering the city.

WAPAKONETA, OHIO.—The Western Ohio Railway Company is planning to build an extension from Minster to Greenville and right of way is being secured.

CANFIELD, OHIO.—The Youngstown & Ohio River Railway Company, represented by Max P. Goodman, of Cleveland, has secured a franchise for its line through town.

NEW PHILADELPHIA, OHIO.—The Post Office authorities have established mail service on the cars of the Tuscarawas Traction Company between Canal Dover and Uhrichsville.

DEFIANCE, OHIO.—The city has granted a franchise to J. Morgan, trustee for the People's Rapid Transit Company, which proposes to build a line from Toledo to Greenville through this town.

CLEVELAND, OHIO.—The Lake Shore Electric Railway is making surprising gains in its earnings. The gross passenger receipts for November were $40,862, an increase of 48.9 per cent. over the corresponding month last year.

PORTSMOUTH, OHIO.—The Portsmouth Street Railway & Light Company has placed a contract with the Westinghouse Elec. & Mfg. Company for the equipment of its new power house. The company will build an extension to Hanging Rock.

COLUMBUS, OHIO.—The Franklin County commissioners have granted an extension of six months for the completion of the line of the Scioto Valley Traction Company. The original franchise required that the road be placed in operation Jan. 1, 1903.

TOLEDO, OHIO.—The Toledo, Fostoria & Findlay Railway Company is about to close a contract for the construction of its Fostoria-Toledo extension. It is understood that a New York engineering concern will secure the contract for building the 35 miles of road.

COLUMBUS, OHIO.—The Columbus, New Albany & Johnstown Railway Company is preparing to extend its line from Gahanna to New Albany and Johnstown. Contracts will be closed in the near future. The company will purchase new rolling stock and may decide later to build a power house.

CLEVELAND, OHIO.—W. D. Young, one of the chief promoters of the Lorain & Eastern Railway Company, announces that construction work on the line will start by January 1. The road will run from Rocky River, seven miles from Cleveland, to Lorain and Elyria. It is claimed right of way has all been secured.

WARREN, OHIO.—The Trumbull County commissioners have notified the Pennsylvania & Mahoning Valley Traction Company that steps must be taken to put the Warren-Leavittsburg extension in operation at once. The road has been laid for some time, but no cars have been operated for reasons best known to the company.

CINCINNATI, OHIO.—Electric passenger service on the Cincinnati, Georgetown & Portsmouth Railway was begun recently with considerable ceremony. For some time to come the regular freight trains will be operated by steam locomotives as the electric locomotives designed for this service have not been completed.

CLEVELAND, OHIO.—Directors of the Cleveland, Elyria & Western Railway Company and the Cleveland & Southern Railway Company met recently and ratified the consolidation of the properties into the Cleveland & Southwestern Traction Company. The proposition will be ratified by the stockholders of both companies at meetings to be held January 15. The new company will also absorb the Norwalk Gas & Electric Light Company.

CLEVELAND, OHIO.—Directors of the Detroit United Railway met in this city recently. It is stated that the company is now earning seven per cent. on its capital stock. The usual quarterly dividend of one per cent. was declared. The directors voted to spend the extra three per cent in improvements, chiefly in rolling stock and extensions. The Sandwich, Windsor & Amherstburg Railway Company, the majority of whose stock is controlled by the Detroit United, will issue a 20-year 4½ per cent. mortgage for $600,000 to provide for the extension of the road to Amherstburg.

TOLEDO, OHIO.—The Toledo & Maumee Valley Railway Company and the Toledo, Waterville & Southern Railway Company have consolidated under the name of the Maumee Valley Railways & Light Company. The capital stock of the new company is $1,000,000 and bonds to the same amount will be issued. The new officers are R. H. Baker, president; E. J. Bechtel, vice-president; Wm. H. McLellan, secretary, and Charles T. Munz. The property is owned by the Everett-Moore syndicate and it is operated by the same management as the Toledo Railways & Light Company. It is understood that the company is going into the electric lighting business with a view to illuminating Maumee, Perrysburg, Waterville and other towns in the valley.

CLEVELAND, OHIO.—It is announced that within sixty days work will start on the construction of the proposed interurban freight station which will be located on Erie Street on property which has been held by the interurban companies for more than a year. The station will be operated by the Suburban Depot Company, interested in which are the Cleveland Electric Railway Company, the Cleveland City Railway Company, the Eastern Ohio Traction Compan, the Northern Ohio Traction Company, the Cleveland, Painesville & Eastern Railway Co., the Lake Shore Electric Railway Co. and the Cleveland, Elyria & Western Railway Company. With the exception of the Eastern Ohio Traction Company the business of these roads is operated by the Electric Package Company. While the station will be devoted almost wholly to freight and express business, there will be waiting rooms for the accommodation of travelers.

COLUMBIA, S. C.—A movement is on foot for the building of an electric railway to Saluda, S. C., a distance of 35 miles.

NASHVILLE, TENN.—An interurban electric railway to Clarksville is being discussed. Application has been made for a franchise by T. N. Watson, who is said to be backed by Clarksville capital.

DALLAS, TEX.—The municipal commissioners of this city have refused to confirm the ordinance passed by the city council authorizing the consolidation of the different street railway systems of this city into the Metropolitan Street Railway Company, which was recently organized by Stone & Webster, of Boston, Mass., with a capital stock of $4,500,000. Mayor Caball says that even should the ordinance have been approved by the commissioners he would have vetoed it.

SALT LAKE, UTAH.—Permanent surveys for the Coeur D'Alene and Spokane electric railway have been completed. The road will be 32 miles long.

RICHMOND, VA.—At a meeting of the directors of the Richmond and Petersburg Electric Railway Company, held in Cleveland, Ohio, F. Sitterding, of Richmond, was elected president and L. C. Spencer, secretary and treasurer.

MONTEREY, MEX.—It is reported that the Baltimore, Md., syndicate which recently acquired the Monterey street railway systems is also negotiating for the purchase of the street tramways of the city of San Luis Potosi, Mexico, and that the deal is likely to be consummated. The Baltimore syndicate has also bought the lines of the Empresa Street Railway Company in Monterey. The latter company operated an extensive system of road connecting the center of the city with the depots and principal manufacturing concerns. The work of constructing the power house, preliminary to converting the combined system into electric lines and the building of extensive new lines is now in progress.

LEGAL.

NERNST LAMP IN GERMANY.—Note is made in a recent issue of the *Zeitschrift Elektrochemie* of a recent action in regard to the Nernst lamp in the courts of Germany. It says: "In the patent suits instituted against the company relative to Nernst lamps, the Imperial Court has reversed the decision of the patent office against the first Nernst patent, and has reinstated this patent to its full extent; the costs of both proceedings to be borne by the complainant." In this case the complainant was one William Boehm, of Berlin. The first Nernst patent in Germany is the broad one referring in general to the use of conductors of the second class, heated by an outside source as a preliminary, and maintained in incandescence by the passage of current.

NEW YORK STREET CAR TAX.—The Appellate Division of the New York Supreme Court has handed down a decision in a number of cases brought to compel various railroad companies in the city to pay a tax of $50 per year on each car owned by them. The cases vary somewhat in details, but in general the Metropolitan Street Railway Company is held responsible for the payment of the tax, as being the lessee company. The city brought a number of suits some time ago to collect this tax, on which some of the companies are in arrears for years. Other suits remain to be brought, but the Corporation Counsel wished first to have it settled which company was responsible, the original or lessor companies, or the lessees. Under the present decision the Metropolitan will have to pay the back tax, which amounts to many thousands of dollars—that is, unless the latest transformation of the Metropolitan into the Interurban Company makes still further litigation necessary.

SUIT ON A TELEPHONE DIRECTORY.—A damage suit, involving a new and novel question, has been instituted in the district court at Houston, Tex., by Anna Ezell, against the Southwestern Telegraph and Telephone Company. Plaintiff sues for $10,000 damages for alleged injury done her good name for which she asserts the defendant company is responsible. She alleges in her petition that on July 15, 1902, she and defendant company had an agreement by which the latter was to place a telephone in her residence which she alleges was done, and that the defendant company was also to furnish her with a telephone directory with her address printed therein as 715 Travis Street, but instead of having her address printed as she had directed it was printed as a number on Texas Avenue. This number on Texas Avenue which was printed in the directory as her address had been for many years, the plaintiff alleges, occupied by notorious public characters and was so generally known by the public; plaintiff further alleges that she became a subject of much ridicule and also of many unpleasant remarks and comments from her acquaintances, which, though, perhaps, meant in a spirit of levity, were upon a repulsive subject and caused her to suffer great humiliation and annoyance, shame and disgrace; that she was slighted and shunned by acquaintances, who feared others who did not understand the real facts in the case would think that they were associating with a woman of bad repute; that defendant company failed to comply with her request that her address be corrected and the telephone directory issue containing the erroneous number be called in.

NEW INDUSTRIAL COMPANIES.

THE PULVERIZED COAL STOKER COMPANY, of New York, has been incorporated with a capital stock of $500,000. The directors are A. A. Day and G. W. Giddings, of Brooklyn, and A. A. Low, of Manhattan.

THE AMERICAN ELECTRICAL SPECIALTIES COMPANY, of New York, has been incorporated with a capital stock of $50,000. The directors are James Jones, Jr., and Julius Silverman, of New York.

THE CHAMBERLAIN LAKE TELEGRAPH AND TELEPHONE COMPANY, of Greenville, Me., has been incorporated, with a capital stock of $10,000. L. B. Folsom is president, H. M. Shaw treasurer.

THE FUSE-WIRE AND MANUFACTURING COMPANY, of Buffalo, N. Y., has been incorporated by Arthur A. Dana and W. H. Crosby, of Buffalo; E. A. Sperry, of Cleveland; H. E. Goodman, of Chicago, and G. B. Smith and F. H. Field, of Brooklyn.

PERSONAL.

MR. T. L. LYMAN, manager of the asbestos department of H. W. Johns-Manville Co., New York, sailed on Dec. 20 for Havana, Cuba, where he will remain about two weeks for the benefit of his health.

MR. L. W. STANTON, the telephone engineer of Cleveland, was a welcome visitor at the Chicago office of ELECTRICAL WORLD AND ENGINEER last week. A great deal of professional work in his field is opening up.

MR. C. H. DALE, president of the Peerless Rubber Manufacturing Company, has been elected president and general manager of the Mechanical Rubber Company, which thus secures an executive of great force and ability.

Mr. B. F. VREELAND, of Denver, Colo., dealer in Idaho red cedar poles, of which he is shipping a considerable quantity east, made a visit to Chicago recently, attending the Interstate Telephone Convention and looking after other interests.

MR. C. C. BADEAU, formerly with the Wagner Electric Manufacturing Company, of St. Louis, has opened an office in the Frick Building, Pittsburg, in behalf of the Cutler-Hammer Manufacturing Company, of Milwaukee, to represent its electric controlling devices.

MR. WILLIAM COALE, the energetic treasurer of the Sterling Electrical Mfg. Co., of Warren, has been a recent visitor to the East and was in New York City last week. He finds that the demand for the Sterling "Special" incandescent lamp shows no sign of lessening.

MR. O. W. BRAIN, the electrical engineer of the New South Wales Government, who has been on this side for the last week or two securing data in connection with the proposed extension of the Sydney City and Suburban Tramways plant, left New York this week, en route for San Francisco, from which place he will sail for Australia on the "Sonoma," Jan. 8.

MR. LAMBERT SCHMIDT, the well-known telephone manufacturer, and his wife were seriously injured in a trolley smash up at Weehawken, N. J., last week. They were returning home from the theatre when three cars that had broken loose from a freight train on the Erie Railroad smashed into the trolley car as it crossed the tracks. About forty persons were hurt in the collision.

DR. H. P. PRATT.—The office of X-ray Expert and Electrical Diagnostician of the Law Department of Chicago has been created and will be filled by Dr. H. Preston Pratt. In his letter tendering the position to Dr. Pratt City Attorney John E. Owens says: "This office has become necessary on account of numerous attempts at fraud through the evidence of X-ray and electrical so-called 'experts' in claims against the city for personal injuries.

MR. LEWIS NIXON, discussing battleship problems in the *World's Work* for January, says: "I have no doubt that soon electric influences will be projected and that the metal work of an enemy's guns may be able to transmit shocks to those serving them. The most important factor we have at present to influence the future navy is the submarine boat. It is a pecularity of this new addition to our fighting force that its influences will be outside itself. By that I mean that so far

as the submarine boat is concerned it is at the very outset a practically perfect craft. Such changes as will be brought about by its enrollment in the navy will be in the conditions to which it is opposed."

MR. FRANK HEDLEY, who has been general superintendent of the Lake Street and Northwestern Elevated railroad companies, Chicago, has resigned to become general superintendent of the underground system of the Interborough Rapid Transit Company of New York. Mr. Hedley, now 40 years old, is descended from an English family that was among the first to be connected with steam and locomotive engineering. His grand-uncle, William Hedley, was the designer and builder of the first traction engine ever constructed in England. Mr. Hedley came to this country in 1882 and entered the Erie Railroad shops as machinist. In 1893 he took the position of superintendent of motive power with the Lake Street Company. He will be a welcome addition to the electro-technical circles of New York City.

MR. HORACE L. HOTCHKISS has transferred his membership in the New York Stock Exchange, and intends to retire from active business, after forty-five years in Wall Street. In 1867, in connection with Mr. E. A. Calahan, the inventor of the stock quotation system, Mr. Hotchkiss organized the Gold and Stock Telegraph Company, of which he was the treasurer, and materially aided in placing that company on a high plane of prosperity. In 1871 he was one of the incorporators of the American District Telegraph Co., and a director and the treasurer for several years. The firm of Hotchkiss & Burnham opened at the Fifth Avenue Hotel the first uptown branch office connected by private telegraph lines for public patronage in connection with their Stock Exchange business. This enterprise on the part of this young firm was considered at that time quite an innovation on the staid methods of conducting the stock brokerage business. Mr. Hotchkiss is congratulated on his retirement by a great many old friends in the telegraph field.

Trade Notes.

THE FISHER ELECTRIC COMPANY, Toledo, Ohio, has increased its capital stock from $10,000 to $25,000.

ELECTRIC HEATERS.—American Electric Heater Company, of Detroit, have made a change of address to 17-19 Spencer Street, that city, in order to secure larger and better facilities for the production of its goods.

ARC LAMP TALK.—"Twenty Chapters of Reasonable Arc Lamp Talk" is the title of a neat little booklet just issued by the Electric Appliance Company, Chicago, which is selling agent for the Adams-Bagnall arc lamps. A copy can be had by sending a postal card.

ELECTRIC BRAKES.—A company has been organized by George F. Campbell, Col. Glen Goss and Gustav DuWeilis, of Cincinnati, Ohio, and Joseph E. Dowling and John Drake, of Dayton, for the manufacture of a new electric brake for traction cars. A factory will be located in Dayton.

FIRE IN LAMP-BULB WORKS.—The plant of the Fostoria Glass Specialty Company was destroyed by fire recently, entailing a loss of about $50,000. The company manufactured bulbs for incandescent lamps and the stock was largely controlled by the Fostoria Incandescent Lamp Company. The insurance was about $17,000.

POWER PLANTS OF THE PACIFIC COAST.—A special edition of the paper read by Dr. F. A. C. Perrine before the New York Electrical Society, descriptive of the great transmission systems of California, has been issued. It includes illustrations of the great Carquinez span, also fifty other illustrations. It is bound in boards, 8¼ x 10¾ in.. Price, 50 cents, postpaid. The book is issued by the Stanley Elec. Mfg. Co., 170 Broadway, N. Y. City.

CHAIN BLOCKS.—One of the most useful devices around a factory or generating station is a chain block for handling heavy pieces of apparatus, etc. The Yale & Towne Manufacturing Company, 9 Murray Street, New York, makes a very complete line of chain blocks for quick service in handling materials, and these devices are described and illustrated in a pamphlet recently issued by the company. These chain blocks are of the differential, duplex and triple types, for occasional use, general use and constant use and best economy, respectively. The triplex chain block is made in lifting capacities up to 20 tons.

TOOL SHARPENING AND GRINDING.—With the title, "A Treatise on Sharpening and Grinding Milling Cutters, Reamers and Other Tools," the Cincinnati Milling Machine Company has issued a handsomely illustrated and printed pamphlet which will be found of much value to those interested in the subject. Following a page of general directions are two extensive clearance tables, and then come many pages of specific instructions for almost every possible application in machine sharpening and grinding. At the head of each of these pages is an excellent half-tone showing the setting of the machine, and below are the necessary instructions and cautions in concise form. Both in conception and execution the pamphlet is a creditable specimen of the type of trade literature which also contributes to the technical literature of an art.

McGUIRE RHEOSTATS.—The McGuire Mfg. Co., 122-132 North Sangamon Street, Chicago, has just issued a neat and instructive catalogue with regard to its well-known rheostats. It is well illustrated and shows a great variety of rheostats, motor starters, speed regulators, dynamo field regulators, theatre dimmers, etc. The motor starters are intended for automatic release, overload release, etc., and are of the button contact or segment contact types, as desired, with knife switches, blow-out fuses and other accessories, in the various needed combinations. The same variety is offered in speed regulators, simple, compound, etc. A neat class of dynamo field regulators is also made, in a wide range of capacities. Then there are theatre dimmers, organ regulators, etc. The pamphlet includes also some excellent connection diagrams, and gives full data, prices, etc. Mr. McGuire stands ready also to build such apparatus to specification.

OUR ROADS ASTONISH FOREIGNERS.—The development of passenger transportation in the United States astonishes all foreigners. Edwin A. Pratt, a representative of the London *Times*, was making some investigations recently at the Grand Central Station, with a view to writing a comprehensive article on American railroads. His inquiries developed the fact that the New York Central has eight passenger trains a day between New York and Chicago, and when he learned that the distance is 980 miles he remarked that it is a marvelous thing. He was still further astonished to find that four of the eight trains make the 980 miles in twenty-four hours, and that one, the Twentieth Century Limited, goes the distance every day, in either direction, in twenty hours. His amazement grew when he was informed that the westbound Twentieth Century Limited carries only Chicago passengers, and will not take a passenger for any other point. He remarked that his people would be equally astounded on learning these facts.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 16, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,064. REISSUE: MOTOR CONTROLLER; G. E. Krause and A. L. Bolen, Indianapolis, Ind. App. filed Nov. 4, 1902. A plurality of electrical resistances forming part of the motor circuit, of a pair of terminals for each of said resistances, and means for changing bridging connections between said terminals whereby the resistances may be placed in series or any number of said resistances placed in parallel with the remaining series arranged resistances.

715,741. INTERCHANGEABLE DIRECT AND ALTERNATING CURRENT ARC LAMP; M. H. Baker, East Liberty, Pa. App. filed March 11, 1902. The clutch mechanism is mounted on a non-vibratory flexible support.

715,797. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed Apr. 7, 1902. The dash pot is constructed to retard the upward movement of the feed mechanism and only a portion of the downward movement.

715,798. INSULATING METALLIC SURFACES OR WIRES; J. A. Heany, Philadelphia, Pa. App. filed April 10, 1902. (See Current News and Notes.)

715,813. INSULATED RAIL JOINT; W. E. Karns, Parkers Landing, Pa. App. filed June 10, 1902. Rubber insulation is vulcanized to the abutting surfaces of the joint.

715,817. COMMUNICATION WITH THE AID OF ELECTROMAGNETIC DEVICES; I. Kitsee, Philadelphia, Pa. App. filed June 19, 1897. The idea is to alternately energize, by means of negative waves, one or both rails of a track in opposite directions and receive such waves at a suitable distance by a receiving apparatus.

715,821. DRIVING MECHANISM FOR MOTOR VEHICLES; J. Ledwinka, Chicago, Ill. App. filed Feb. 10, 1902. The motor frame is secured to the fixed axle, the armature extending through a hollow hub and gearing with the drive wheel.

715,827. RHEOSTAT; F. Mackintosh, Schenectady, N. Y. App. filed May 22, 1901. Resistance coils are supported between two parallel open-work frames.

715,875. HIGH POTENTIAL INSULATOR; G. H. Rupley, Schenectady, N. Y. App. filed June 13, 1901. Two concentric tubes of insulating material with a filling of insulating material, such as oil, between them.

715,878. SWIVELING TRUMPET FOR TELEPHONES; Arthur Schoeler, Elberfeld, Prussia. App. filed April 7, 1902. (See page 1044.)

715,901. CONTROLLING ELECTRIC ARCS; E. Thomson, Swampscott, Mass. App. filed April 12, 1902. (See Current News and Notes.)

715,917. OUTLET OR JUNCTION BOX; M. F. Whiton, Hingham, Mass. App. filed April 17, 1902. Sheet metal caps are held in place in the openings of the box by clips.

715,920. ELECTRIC BATTERY; D. H. Wilson, Chicago, Ill. App. filed April 30, 1902. The carbon element consists of two cups integral with each other, separated by a space and opening in opposite directions.

715,930. TRANSFORMER FOR POLYPHASE ALTERNATING CURRENTS; E. Ziehl, Berlin, Germany. App. filed June 20, 1902. The cores have two long sides connected by intermediate bridge pieces. The coils for each phase are placed half on one long side and half on the other and between two bridge pieces.

715,941. COIL TAPING MACHINE; W. H. Bangs, Atlanta, Ga. App. filed April 11, 1902. Details.

715,975. CONTROLLER FOR ELECTRIC MOTORS; E. R. Carichoff, East Orange, N. J. App. filed Aug. 1, 1901. A spring is compressed between each notch and released suddenly to give the required quick movement.

715,976. ROD COUPLING; P. Carolan, Cleveland, O. App. filed Aug. 4, 1902. Details.

715,983. TROLLEY WHEEL; L. Chroninger and J. E. Adams, Findlay, O. App. filed May 21, 1902. A spiral track is formed on cones on each side of the wheel to conduct the wire into the central groove in case it becomes displaced.

715,999. TELEPHONE SYSTEM; William M. Davis, Chicago, Ill. App. filed June 17, 1901. (See page 1044.)

716,000. APPARATUS FOR COMMUNICATING SIGNALS THROUGH SPACE; L. De Foresst, Chicago, and E. H. Smythe, Freeport, Ill. App. filed July 5, 1901. (See Current News and Notes.)

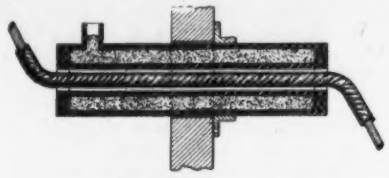
716,008. WORKING ZINC AND SUBSTANCES CONTAINING SILICIC ACID IN ELECTRIC FURNACES; A. Dorsemagen, Wesel, Germany. App. filed August 24, 1901. (See Current News and Notes.)

716,048. ELECTRIC HEATER; J. H. Jenkins, Schenectady, N. Y. App. filed April 24, 1897. The resistance consists of a flexible core bent into a series of alternate coils and a resistance wire wound helically around the coils of said core.

716,056. STORAGE BATTERY; E. J. Knapp, Chicago, Ill. App. filed May 19, 1902. Corner caps are applied to the plate to act as stiffeners.

716,065. AUTOMOBILE; J. Ledwink, Chicago, Ill. App. filed Jan. 31, 1902. The casing of the motor is made integrally with the axle and on the end of the latter next to the wheel.

716,101. ELECTRIC RAILWAY; W. B. Potter, Schenectady, N. Y. App. filed April 28, 1900. A plurality of sources of current, a supply circuit, a control circuit and means brought into action by the control circuit for connecting the supply circuits with any one of the sources of current.



715,875.—High Potential Insulator.

716,102. COMPOUNDING DYNAMO ELECTRIC MACHINES; E. B. Raymond, Schenectady, N. Y. App. filed Oct. 31, 1896. The combination with an electric circuit of a shunt transformer, a series transformer shunted by a phase-shifting device, and a circuit connecting the secondaries in series, with their electromotive forces in partial opposition.

716,103. ELECTRIC MEASURING INSTRUMENT; R. H. Read, Schenectady, N. Y. App. filed May 20, 1901. Comprises a current carrying spiral mounted in a magnetic field and arranged to give a deflection by a change of shape of the spiral under change of currents.

716,110. VACUUM PUMP OR EXHAUSTER; T. A. Rose, London; W. A. Gwynn, Walthamstow, and A. M. Barnes, London, England. App. filed April 18, 1902. A piston of magnetic material is moved by an external magnet.

716,113. DRIVING MECHANISM OF MOTOR CARS; A. Schmid, Havre, France. App. filed Jan. 28, 1902. Engine, dynamo, motors and controller, all mounted on the same vehicle.

716,125. ELECTRIC RAILWAY; E. A. Sperry, Cleveland, O. App. filed Oct. 20, 1902. A traction rail engaged by suitable spur-wheels, also serves as the "third-rail."

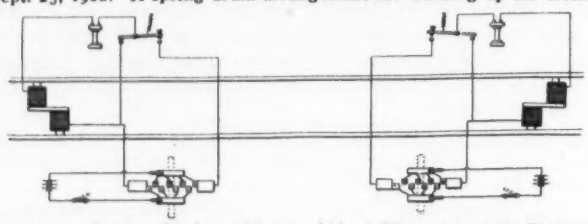
716,134. METHOD OF DETERMINING THE DIRECTION OF SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

716,135. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

716,136. APPARATUS FOR SIMULTANEOUSLY TRANSMITTING AND RECEIVING SPACE TELEGRAPH SIGNALS: J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

716,137. METHOD OF SIMULTANEOUSLY TRANSMITTING AND RECEIVING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

716,145. TROLLEY CATCHER; A. Thode, Hamburg, Germany. App. filed Sept. 25, 1902. A spring drum arrangement for winding up the trolley cord.



715,817.—Communication with the Aid of Electromagnetic Devices.

716,155. ELECTRIC CABLE; J. H. West, Berlin, Germany. App. filed Sept. 21, 1901. A zig-zag strip of paper having notches in its edge in which the wires are seated.

716,178. RAILWAY SIGNALING SYSTEM; H. Bezer, New Rochelle, N. Y. App. filed Nov. 25, 1898. Improvement in a signaling system devised to force the action of the armature which determines the giving of a danger signal, also the removal of effects of sparking, also provision for setting the signals at danger in case of disarrangement of the circuit or apparatus.

716,179. RAILWAY SIGNALING SYSTEM; H. Bezer, Kingsland, N. J. App. filed Dec. 6, 1899. A modification of the preceding invention.

716,182. CARBOPHOSPHID OF CALCIUM; C. S. Bradley, Avon, N. Y., and R. H. Read and C. B. Jacobs, East Orange, N. J. App. filed April 20, 1898. (See Current News and Notes.)

716,186. COMBINED TELEPHONE AND TELEGRAPH SYSTEM; Charles E. Buell, Camden, N. J. App. filed Feb. 26, 1902. (See page 1044.)

716,189. MOTOR CONTROL SYSTEM; F. E. Case, Schenectady, N. Y. App. filed June 3, 1901. A motor controller consisting of a group of independent elements arranged to control both the direction of rotation and the speed of one or more motors, each of said elements comprising a single set of contacts connected to the motor circuit and means for actuating the same.

716,193. DYNAMO ELECTRIC MACHINE; O. F. Conklin, Springfield, O. App. filed Aug. 11, 1902. Fan blades on the armature shaft drive air through radial spaces between the coils.

716,200. CONTROLLING ELECTRIC MOTORS; M. W. Day, Schenectady, N. Y. App. filed Nov. 2, 1899. A combined magnetic and friction brake for electrically propelled devices, comprising connections for putting the motor on short circuit when the supply circuit is broken, a brake-releasing coil in series with the motor, and an auxiliary brake-releasing coil in shunt to the armature.

716,203. WIRELESS TELEGRAPHY; L. De Forest, Chicago, and E. H. Smythe, Freeport, Ill. App. filed Sept. 1, 1900. (See Current News and Notes.)

716,206. INDUCTANCE COIL; F. Dolezalek, Halensee, Germany. App. filed July 19, 1902. The core consists of small iron particles moulded together with insulating material and the coil is made up of fine wires bunched together and surrounded by a common sheath of insulating material.

716,216. END PLAY DEVICE FOR ROTARY MACHINES; H. Geisenhoner, Schenectady, N. Y. App. filed June 14, 1901. A rotary cam adapted to engage the revolving element at one limit of its end play and a cushion co-operating with the cam to assist its lateral thrust on the movable element.

716,222. RHEOSTAT; J. L. Hall, Schenectady, N. Y. App. filed June 27, 1901. A swinging frame carrying a magnet is adapted to lock the arm at any position of its movement and automatically release whenever the current fails.

716,252. ELECTRIC BRUSH; R. D. Laughlin, Ravenna, O. App. filed May 10, 1902. A laminated brush composed of alternate layers of carbon and plumbago.

716,278. COOLING DYNAMO ELECTRIC MACHINES; H. G. Reist, Schenectady, N. Y. App. filed June 26, 1901. A tubular frame having deflecting wings therein to direct air through all parts of the frame.

716,293. SUPERVISORY SIGNAL FOR TELEPHONE EXCHANGE SYSTEMS; C. E. Scribner, Chicago, Ill. App. filed April 1, 1901. (See page 1044.)

716,301. SIGNALING; R. C. Spaulding, Montclair, N. J. App. filed Jan. 29, 1902. A signal device consisting of a simultaneously operated horn and electric flash light.

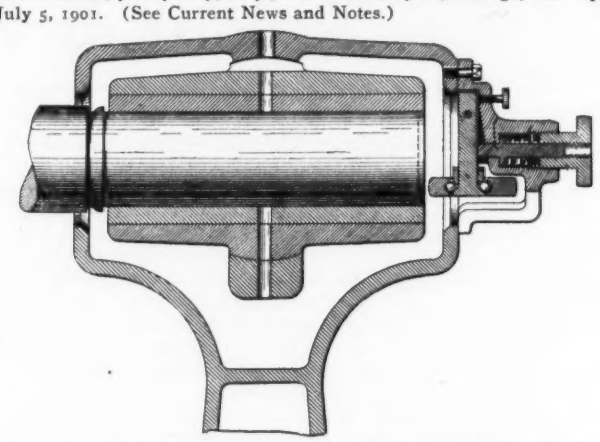
716,302. COMBINED TELEPHONE, TELEGRAPH, ELECTRIC-LIGHT AND POWER SYSTEM; Alexander McMartin, Toronto, Can. App. filed July 12, 1901. (See page 1044.)

716,306. PROCESS OF ELECTROLYTICALLY PREPARING MEDALS AND ALLOYS FOR LITHOGRAPHIC PURPOSES; O. C. Strecker, Cologne, Germany. App. filed April 19, 1900. (See Current News and Notes.)

716,311. ELECTRICAL CONDUCTOR; E. Thomson, Swampscott, Mass. App. filed May 23, 1902. (See Current News and Notes.)

716,329. ANTISEPTIC PROTECTOR FOR TELEPHONE-MOUTHPIECES; Robert I. Willmarth, San Francisco, Cal. App. filed Feb. 13, 1902. (See page 1044.)

716,334. METHOD OF COMMUNICATING SIGNALS THROUGH SPACE. L. De Forest, Jersey City, N. J., and E. H. Smythe, Chicago, Ill. App. filed July 5, 1901. (See Current News and Notes.)



716,216.—End-play Device for Rotary Machines.

716,345. COMPOUNDING DYNAMO ELECTRIC MACHINES; E. B. Raymond, Schenectady, N. Y. App. filed Oct. 31, 1896. The method of regulating a main circuit, which consists in applying to a secondary circuit in series two alternating electromotive forces, one dependent upon the voltage of the main circuit, and one upon the current in the main circuit, the two electromotive forces being dephased by an angle greater than a right angle, and compensating by the variation of current in said secondary circuit for the variation of electromotive force in the main circuit caused by shifting of phase of current in said circuit.

716,355. METHOD OF REGULATING MULTICIRCUIT GENERATORS; H. H. Wait, Chicago, Ill. App. filed May 5, 1902. The method of preventing undue sparking in multicircuit generators under conditions of unequal load on the different circuits, which consists in maintaining the electro-motive forces in the short circuited coils at their proper values by varying the components which produce these electromotive forces, to compensate for the changes caused by the unequal distribution of the armature reaction.

716,356. REGULATING MECHANISM FOR MULTICIRCUIT GENERATORS; H. H. Wait, Chicago, Ill. App. filed May 5, 1902. Details.

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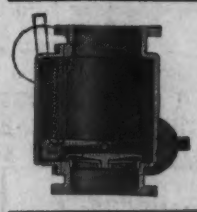

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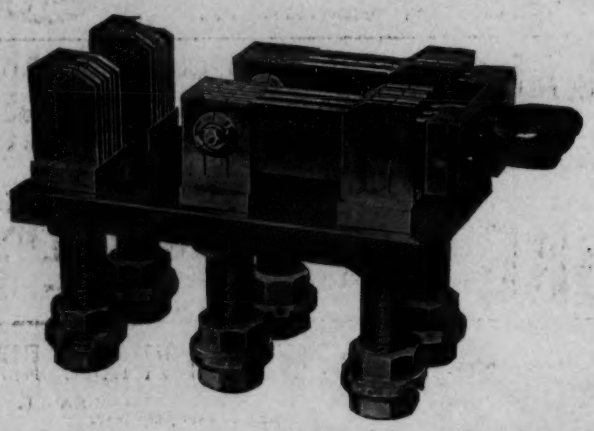

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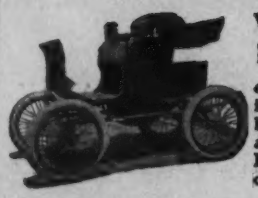

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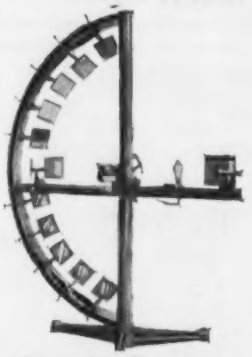

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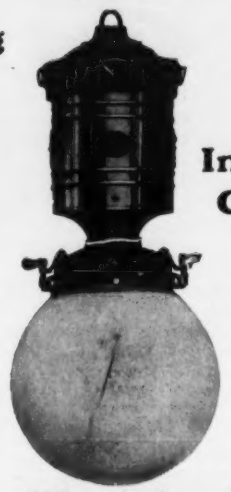

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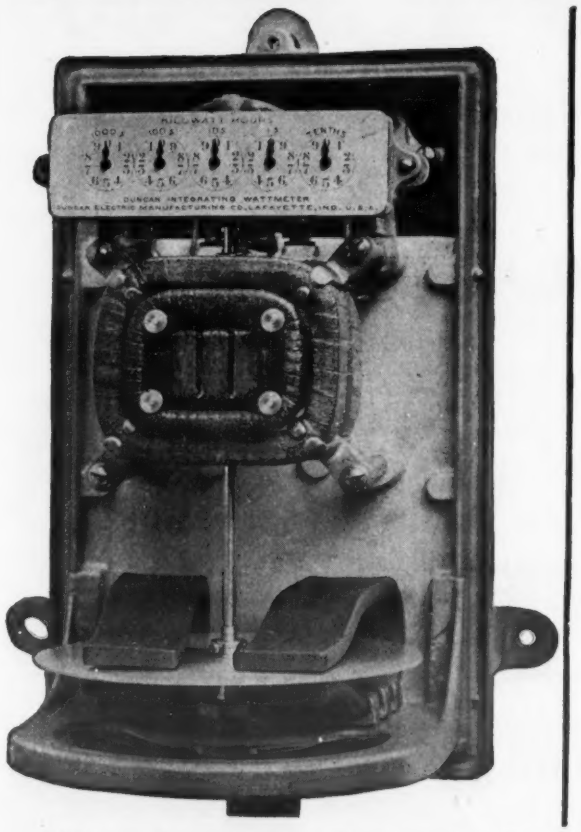

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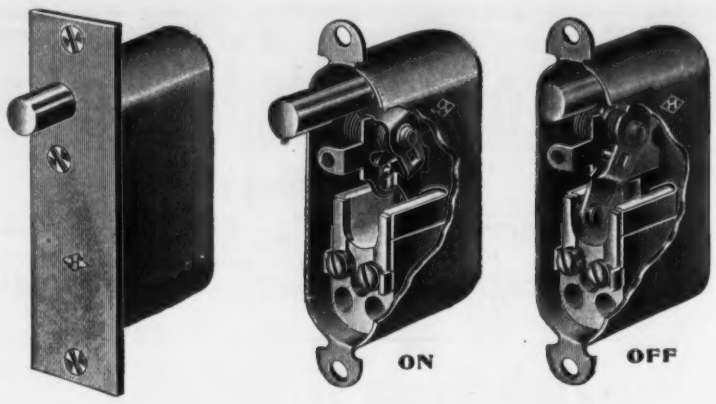

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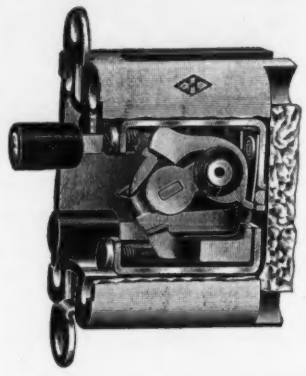

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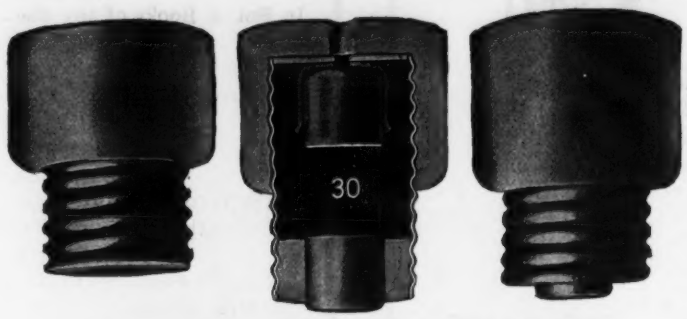

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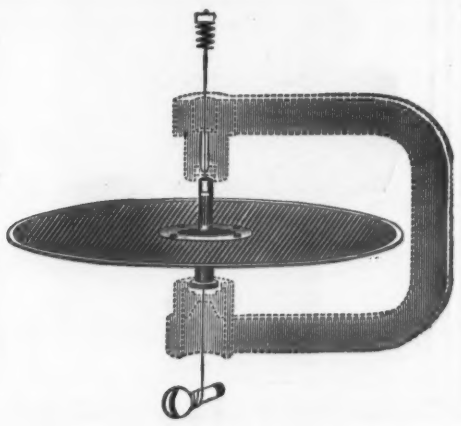

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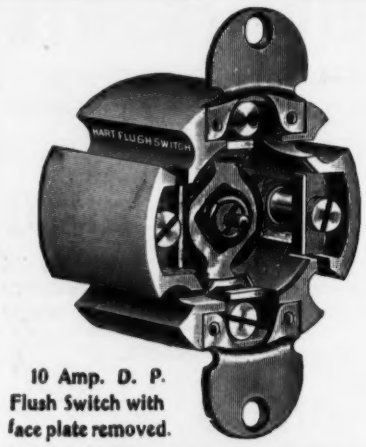
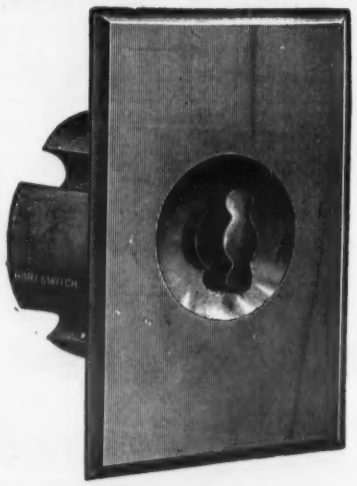


10 Amp. D. P. Flush Switch with face plate removed.



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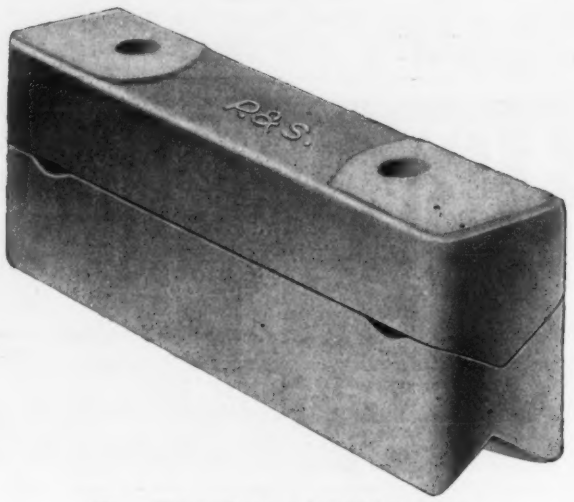

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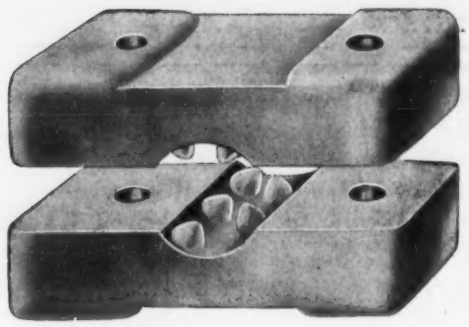

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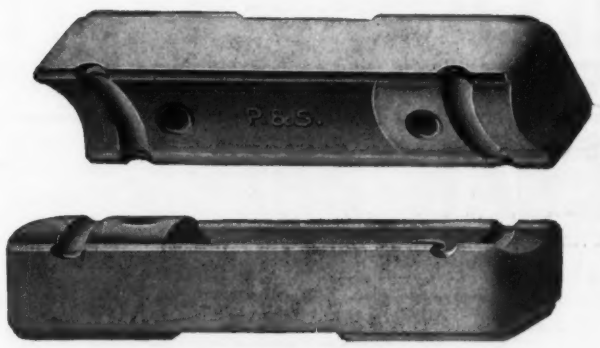

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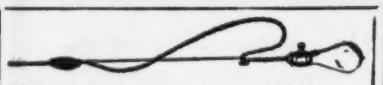

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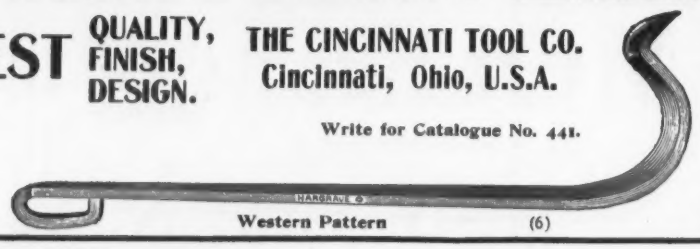

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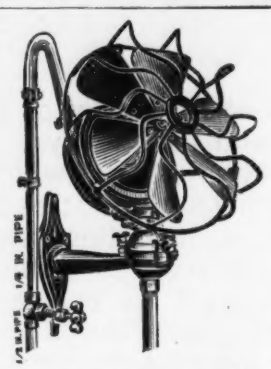

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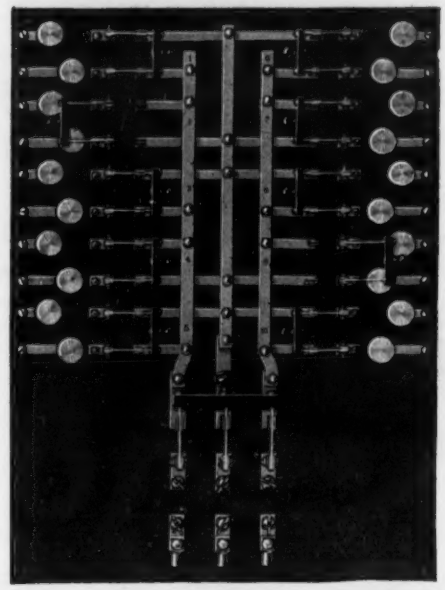

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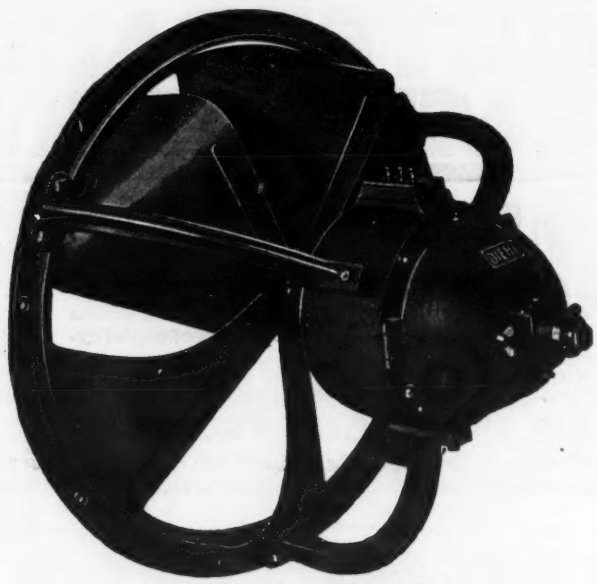

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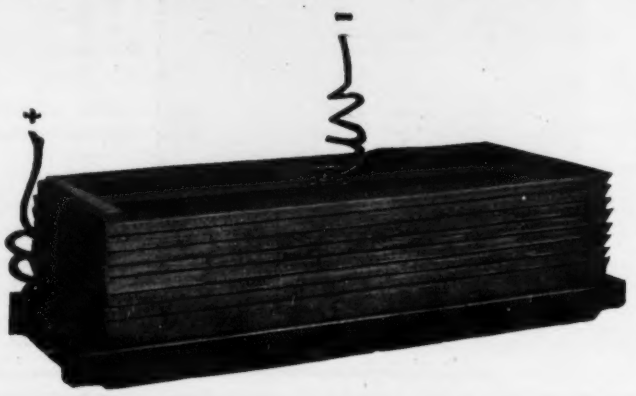

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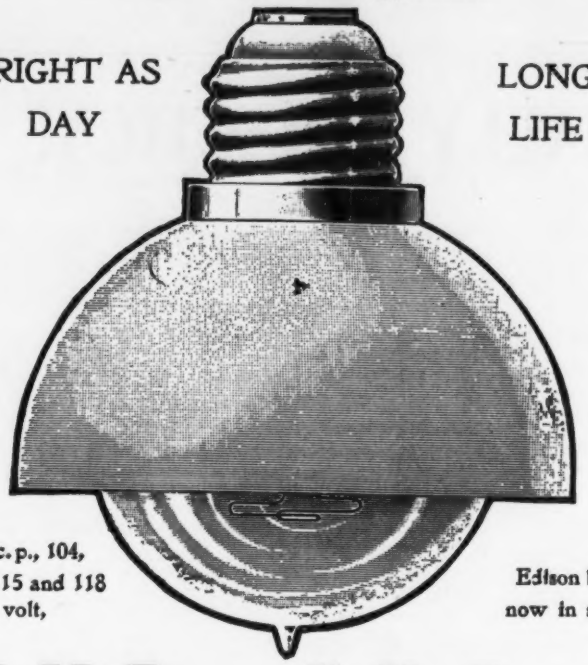

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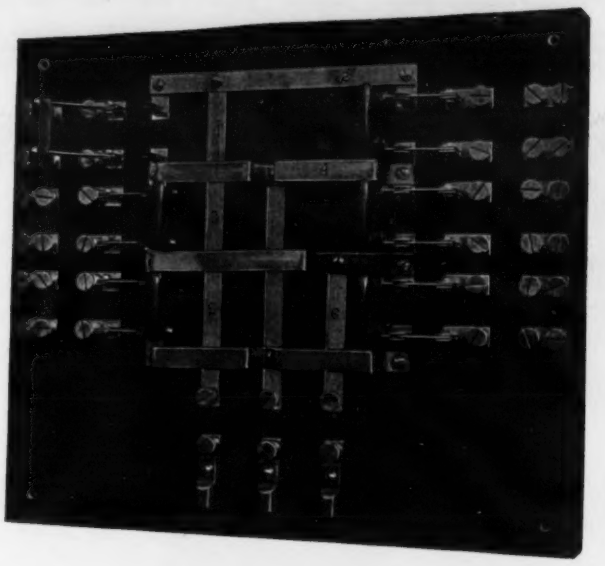

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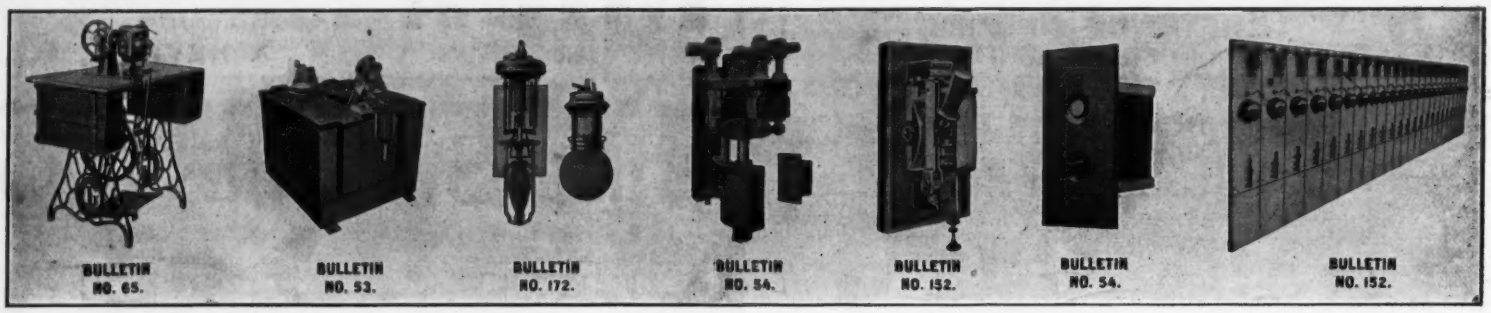

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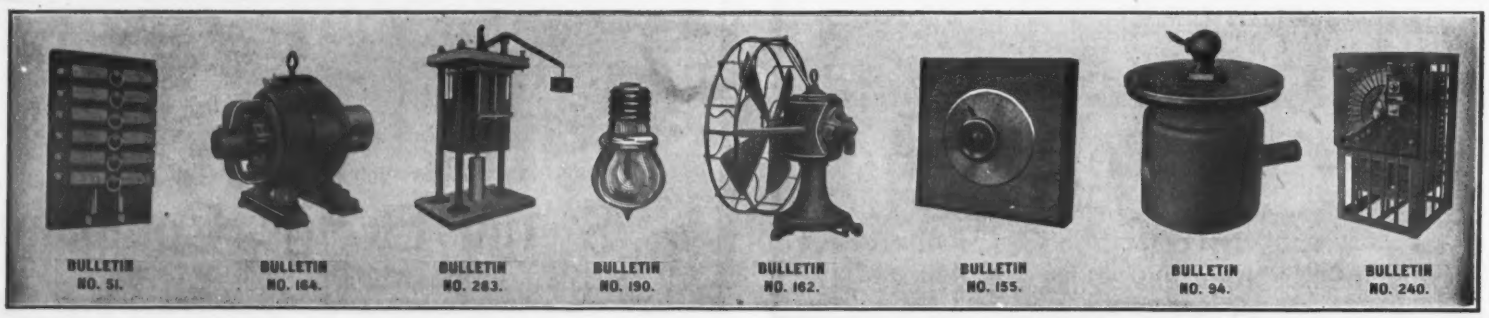

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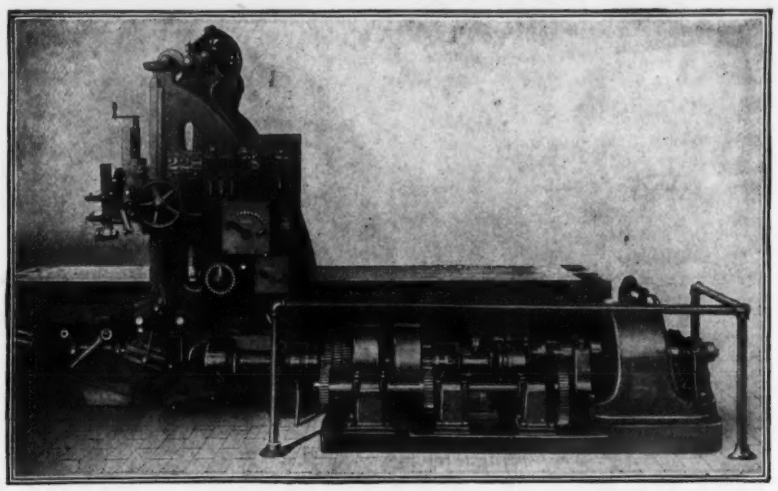

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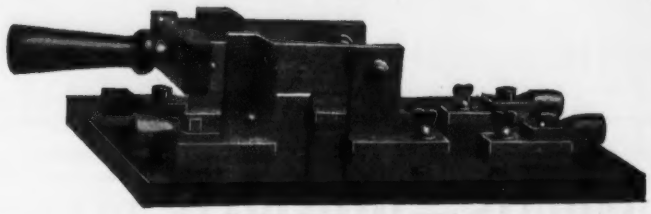

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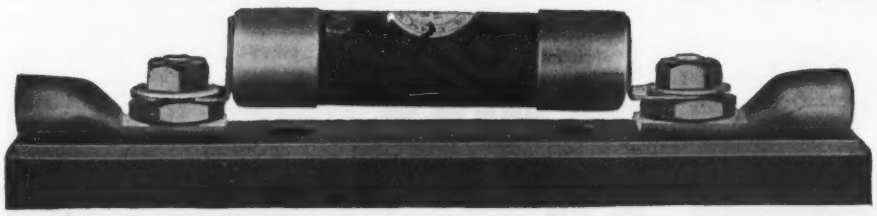

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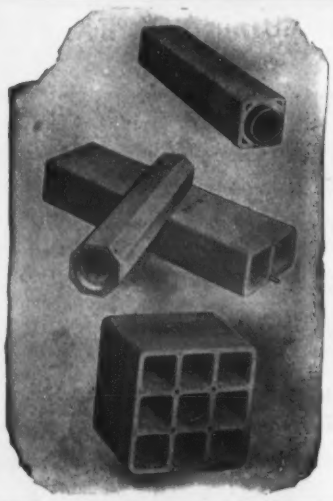

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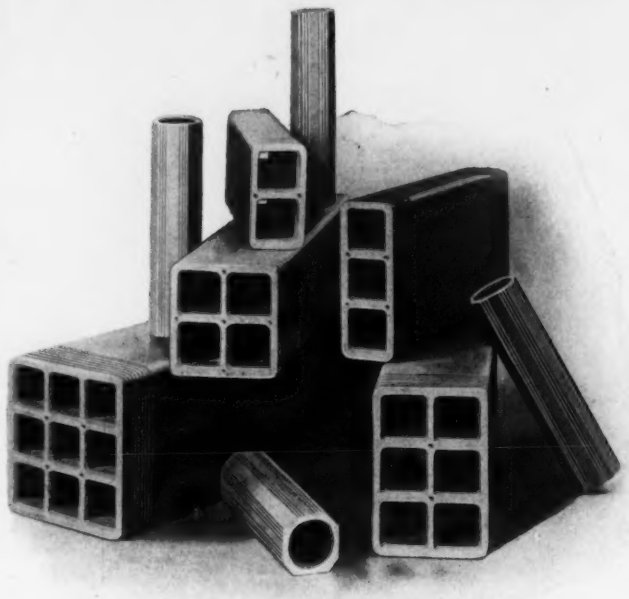

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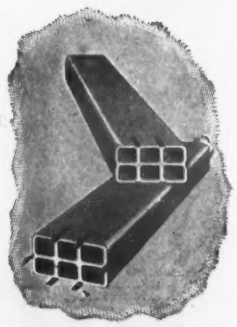

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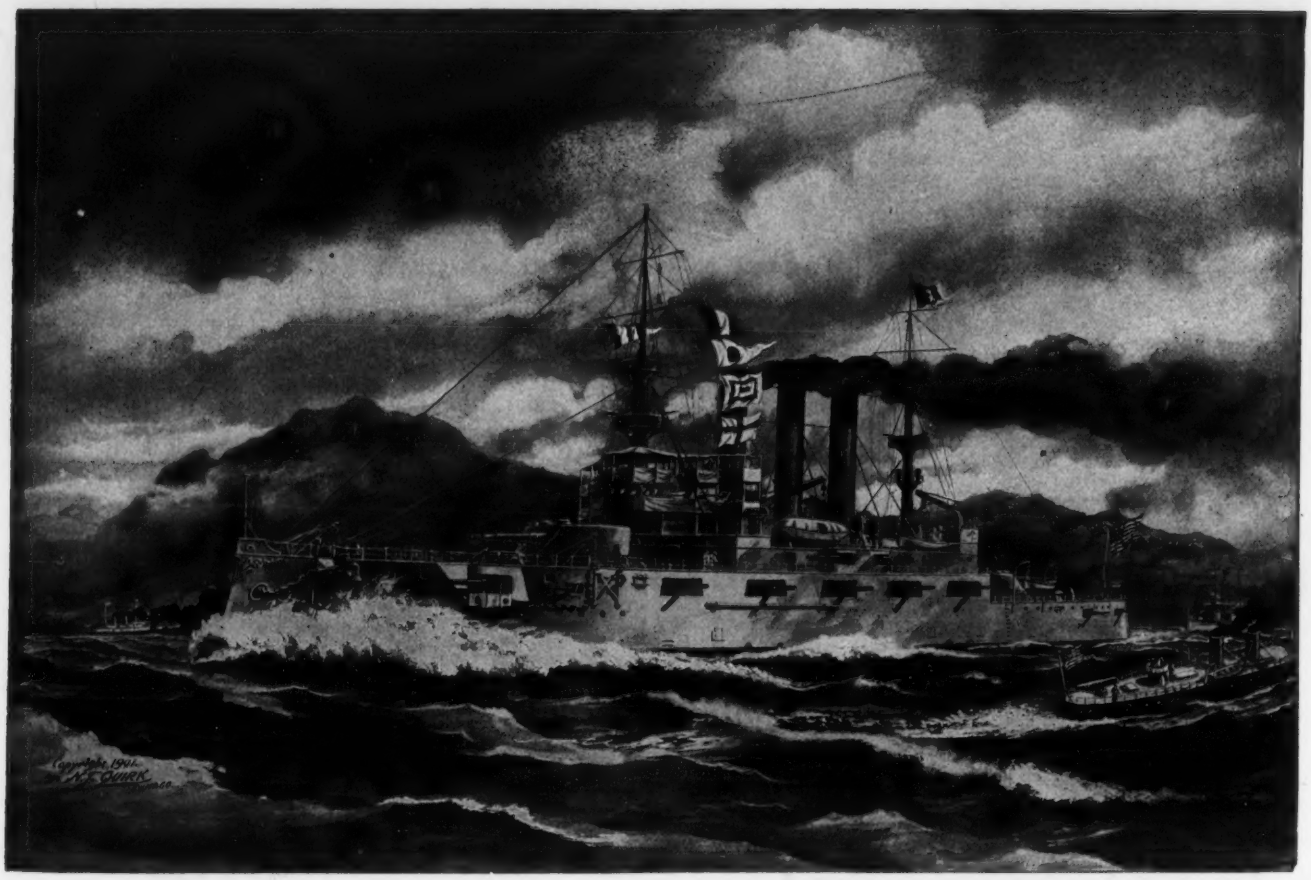

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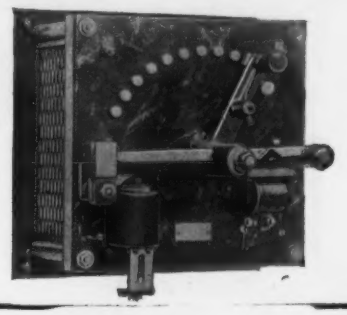

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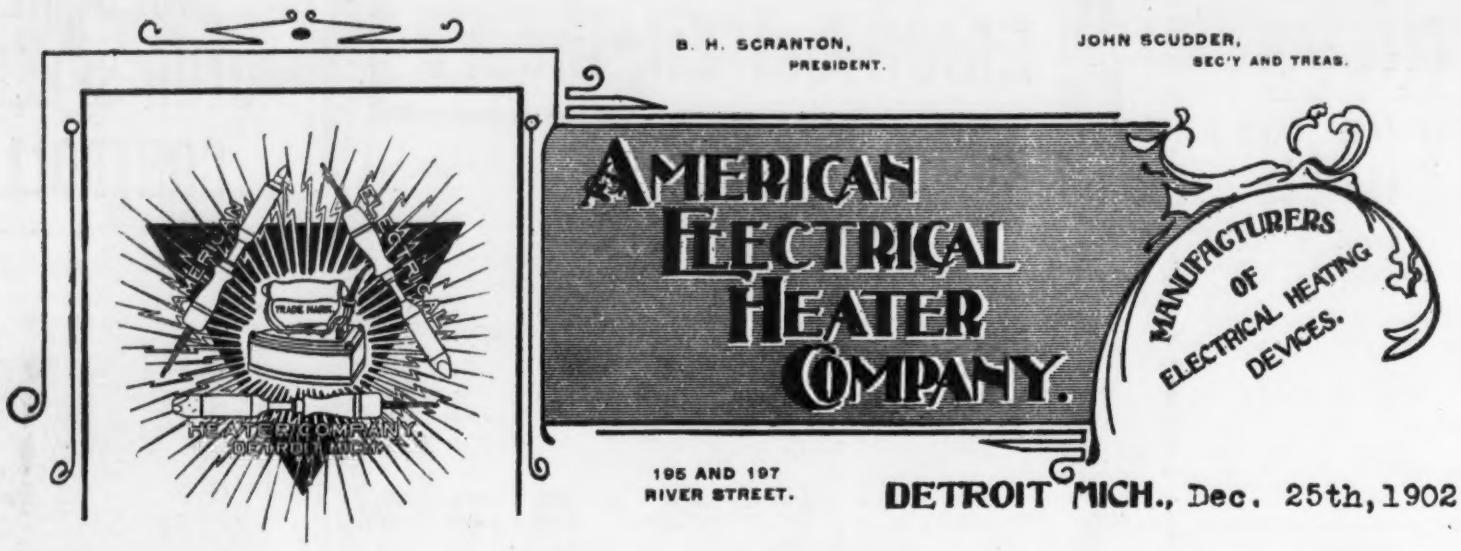

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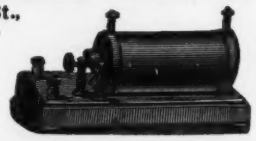

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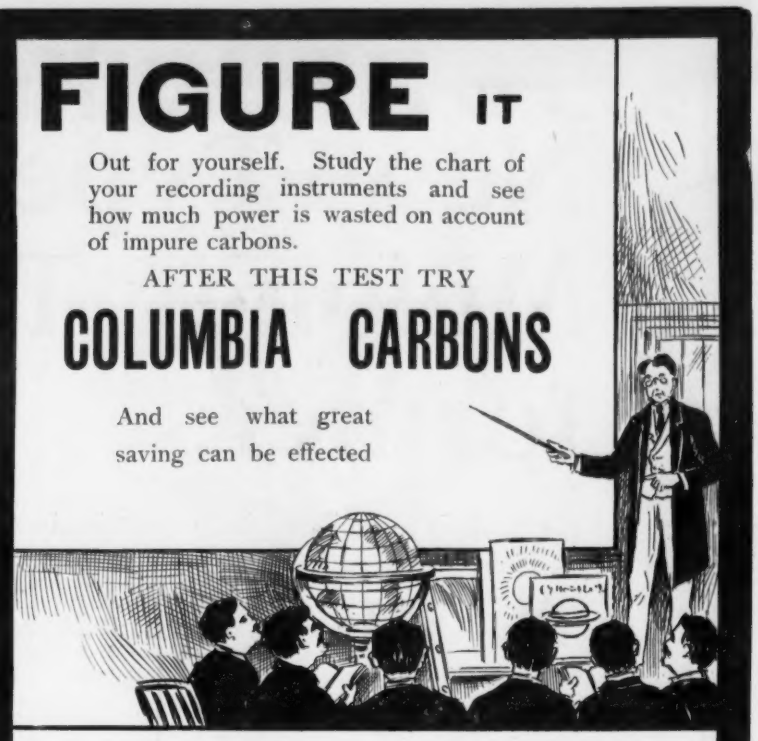

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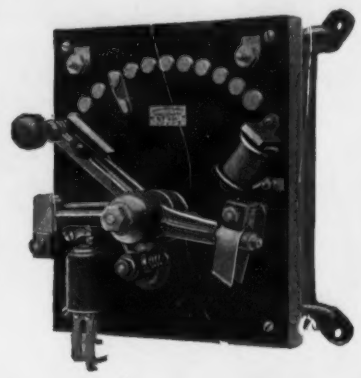

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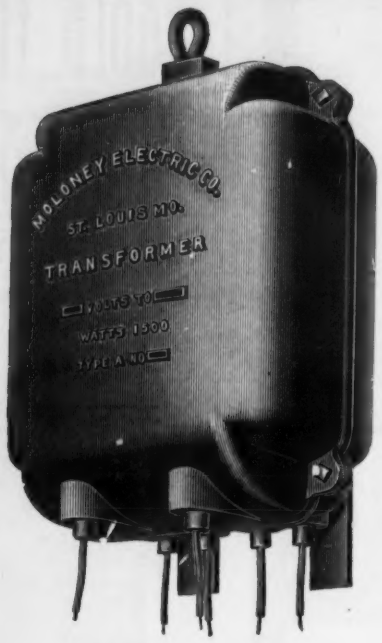

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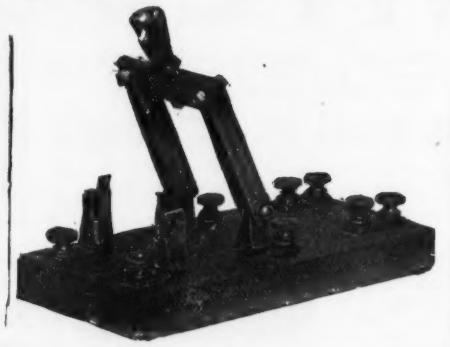

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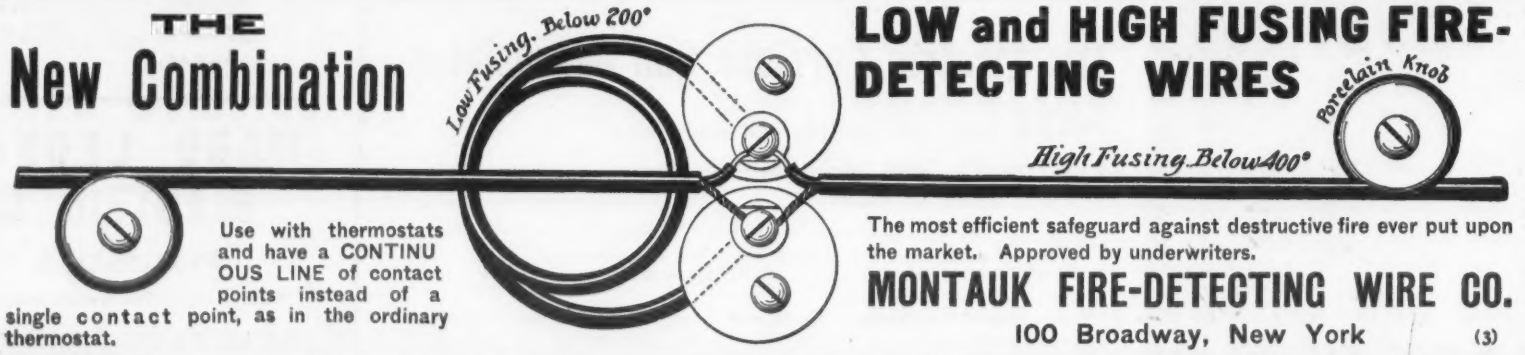

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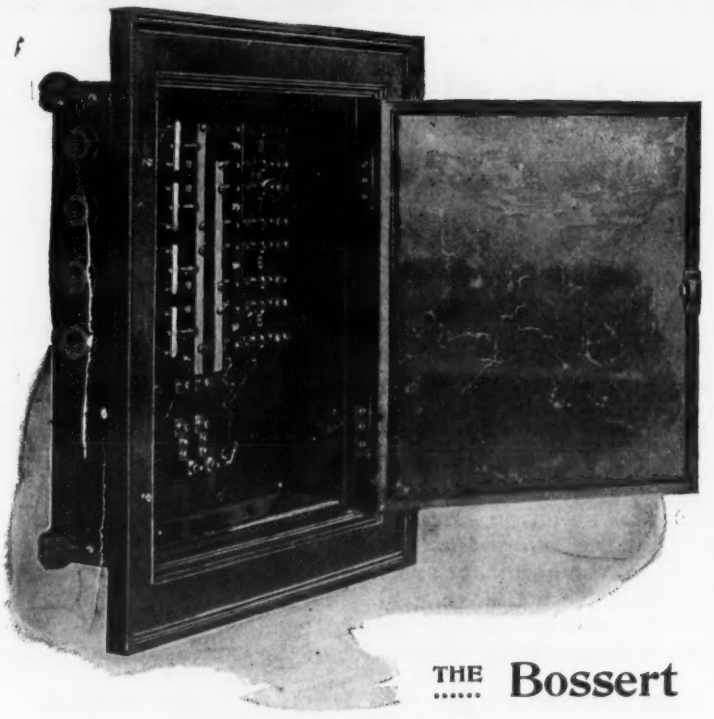

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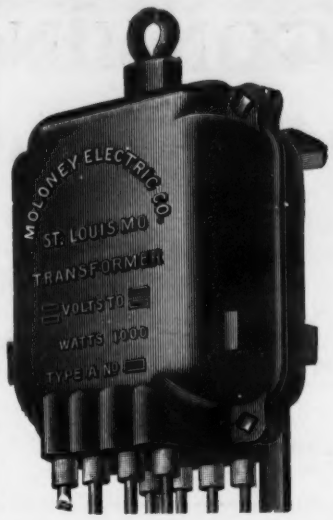

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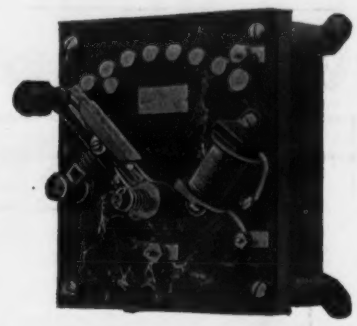

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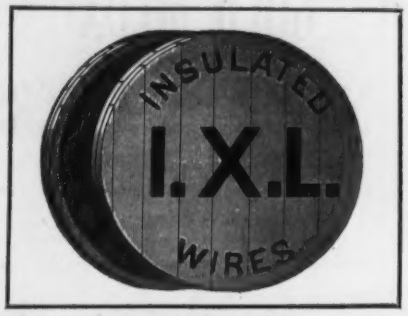

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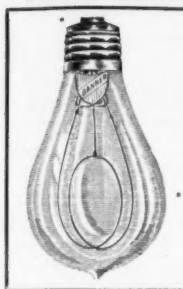

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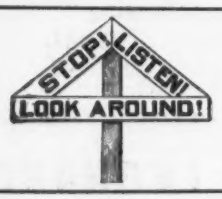

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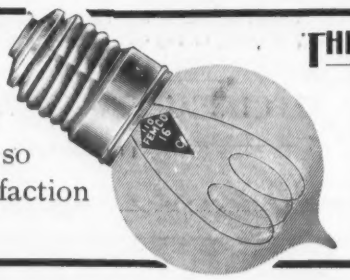

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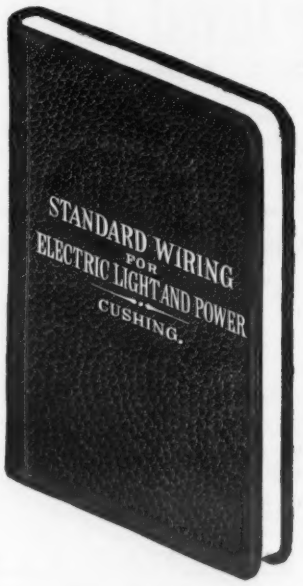

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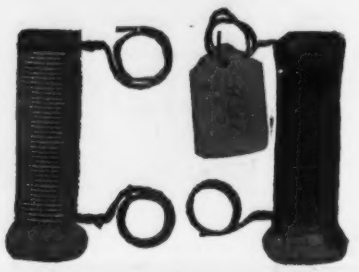

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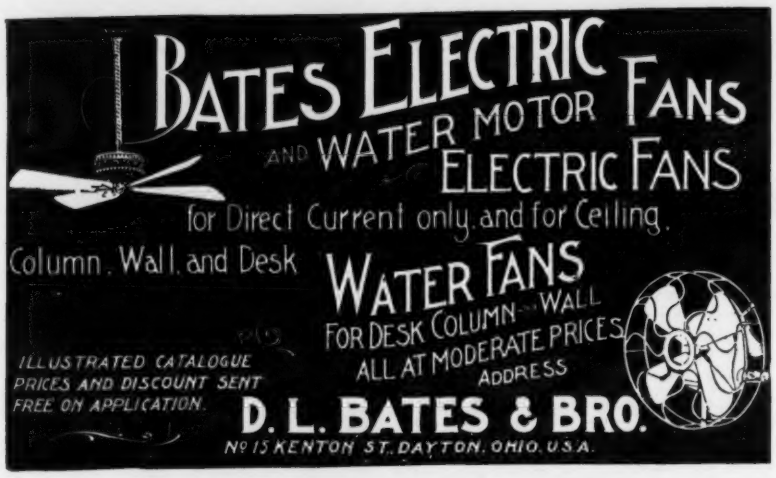
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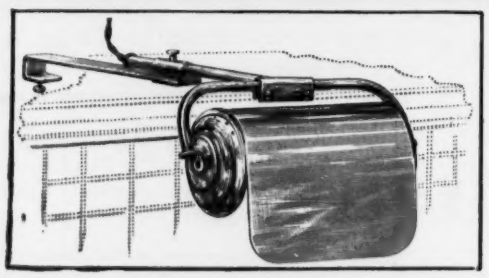

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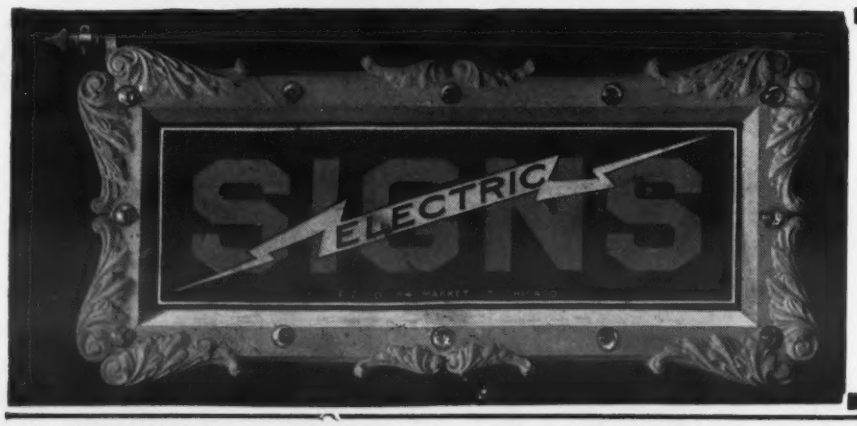

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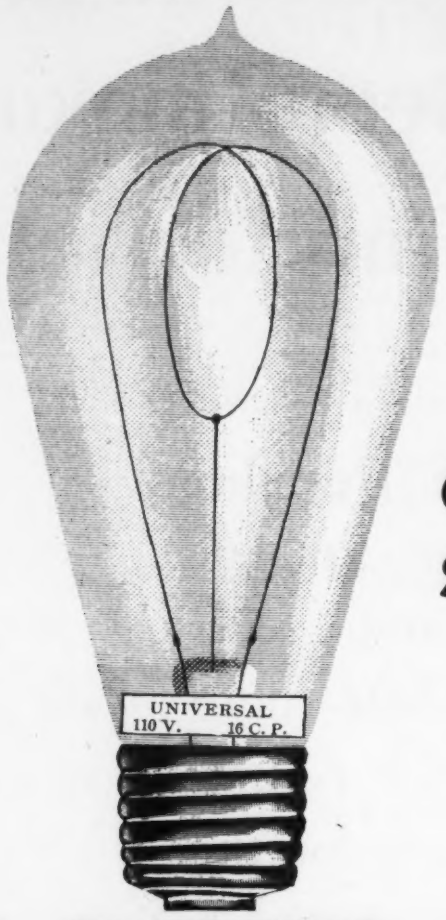

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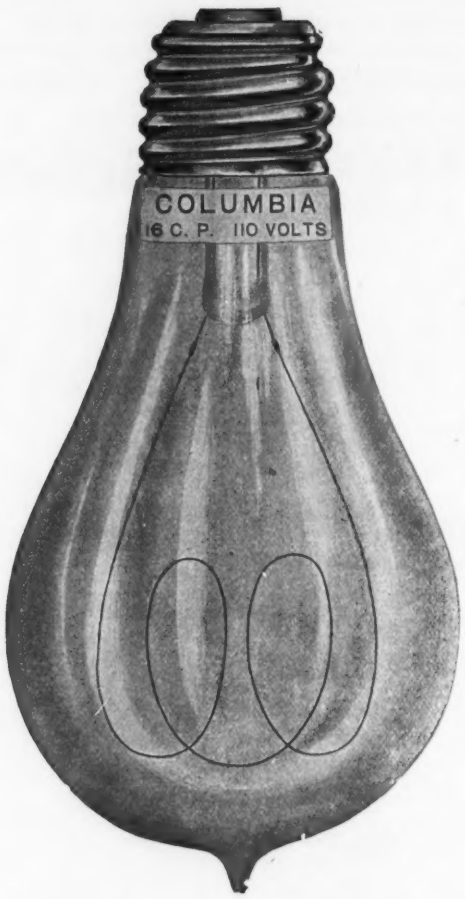

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Electric Controller & Supply Co..... 15
Electric Gas Lighting Co. 27
Electric Launch Co. 31
Electric Mach'y Co. 61
Electric Storage Battery Co. 42
Electrical Engineer Inst. of Cor. Inst.. 19
Electrical Specialty Co. 1
Electro-Dynamic Co. 3
Electrolysis Proof Conduit Mfg. Co.... 16
Elliott Bros. Elec. Co. 54
Elliott & Hatch Book Typewriter Co.. 8
Elwell-Parker Electric Co., The..... 68
Emerson Electric Mfg. Co. 2
Empire China Works 47
Empire Elecl. Instrument Co. 1
Empire Wire Co. 1
Engineers, Directory of ..... 54 and 55
Ericsson Telph. Co. 58
Eyanson & Co., G. T. 40

Faber, A. E. 71
Faries Mfg. Co. .....
Farr Telephone & Const. Supply Co..
Federal Elec. Co. .....
Federal Elec. Co. 28
Felt & Co., Chas. E. 54
Ferracute, Mach. Co. 69
Foote, Pierson & Co. 4
Ft. Wayne Electric Works 60
Ford, Bacon & Davis 54
Franklin Electric Mfg. Co., The..... 26
Freer & Partlow 47
Frick Co. 75
Frink, I. P. 35
Fuller, Co., The 73

Garton-Daniels Co. 36
Garvin Machine Co. 71
General Electric Co. 43
Gen. Incandescent Arc Light Co. 14
Geis & Co., Wm. V. 8
Gest, G. M. 16
Goepel & Niles 47
Goltz Eng'g Co. .....
Gordon Battery Co. .....
Goulds Mfg. Co. 75
Gould Storage Battery Co. 3
Graton & Knight Mfg. Co. 47
Graves Motor Mfg. Co. 47
Green Fuel Economizer Co. 75
Gregory Electric Co. ..... 48 and 49

Hanson & Van Winkle Co., The.... 67
Hardinge Bros. 71
Harrington, C. J. 16
Harrisburg F'd'ry & Mach. Wks..... 75
Hart & Hegeman Mfg. Co. 8
Hart Mfg. Co. 6
Hartford Faience Co. 47
Hartford Stm. Boiler Insp. & Ins. Co.
Hazard Mfg. Co. .....
Heald & Son, L. S. .....
Heck, Louis 52
Helios-Upton Co. 12
Hemingray Glass Co. 33
Hering, Carl 54
Hewitt & Co., Inc., C. E. 54
Hill Elec. Co., W. S. 13
Hoffman, George W. 48
Holmes Fibre Graphite Co. 60
Holophane Glass Co. 2
Holtzer-Cabot Elec. Co. 59
Homer Commutator Co. 52
Hook, F. E. .....
Horry, Wm. Smith 54
Hubbell, Harvey 26
Humphrey, Henry H. .....
Hunt Co., C. W. 68
Hunter Machine Co., The James.....
Hutton Engineering Co. 55

Ide & Sons, A. L. 76
Illinois Electric Specialty Co. 4
Illinois Maintenance Co. 51
Incandescent Elec. Lt. Manip. Co. 10
India Rubber and G. P. Ins. Co. .. 39
Indiana Rubber and Ins. Wire Co. 1
Inland Printer Co., The.....
Insulating Saddle Staple Co. .....
International Brass and Elec Co., Inc. 21
International Correspondence Schools.
International Teleph. Mfg. Co., The.. 58

Jaeger Miniature Lamp Mfg. Co. 80
Jandus Elec. Co. 4
Jeffrey Mfg. Co., The..... 70
Jenkins Bros. 1
Jenney Elec. Mfg. Co. 67
Jessop & Sons, Wm., Ltd..... 70
Jewell Electrical Inst. Co. 36
Johns-Manville Co., H. W. 7
Johnson & Morton 22
Johnston, Thomas J. 47

Kartavert Mfg. Co. .....
Kellogg & Co., E. H. 80
Kellogg Switchboard & Sup. Co. 56
Keystone Elec. Co. 61
Keystone Electrical Telephone Co. 58
Keystone Elec. Inst. Co. ..... 1 and 15
Kilbourne & Clark Co. ..... 1 and 4
Kinsman Electric & Railway Supply Co 42
Klein & Sons, Mathias..... 10
Kleinschmidt, E. 80
Klipstein & Co., A. .....
Knapp Electric & Novelty Co. .....
Knowles, Edward R. .....
Kohler Bros. 55
Krantz Mfg. Co., H. 10
K. & W. Co. .....

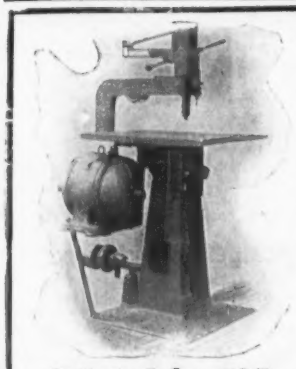
Lakon Co., The 39
Lamp Testing Bureau 46
La Roche Co., F. A. .....
Leclanche Battery Co. 3
Leffel & Co., James 44
Leslie & Co., A. C. 4
Liberty Elec'l Supply Co. .....
Lincoln Elec. Co. 64
Link-Belt Engineering Co. 68
Lippincott Glass Co. 68
Locke Insulator Mfg. Co., The..... 35
Lombard Governor Co., The.....
Long & Allstatter Co. 70
Louis Mfg. Co. 80
Lovell & Co., F. H. 35
Lowell Model Co. 77
Lunkenheimer Co., The 73

McGill University .....
McGowan & Co., The John H. 69
McGuire Mfg. Co. 25
McIntire Co., The C. 3
McIntosh, Seymour & Co. 76
McLennan & Co., K. 48
McLeod, Ward & Co. 26
Machado & Roller 35
Mailloux, C. O. 55
Maltby Lumber Co. 10
Manhattan Elec'l Supply Co. 27
Manross, F. N. .....
Marinette Iron Works Mfg. Co. 72
Maris Bros. 69
Marshall, William 80
Matthews & Bro., Wm. N. 11
Mayer Electric Co., M. M. 67
Mead Mfg. Co., J. A. 69
Mechanical Appliance Co. 60
Mechanical Boiler Cleaner Co. 72
Mendes Cutting Factories 47
Meyrowitz, E. B. 35
Mica Insulator Co. 35
Michigan College of Mines 44
Mietz, A. .....
Moloney Elec. Co. 25
Monson Burmah Slate Co., The..... 52
Montauk Fire Detecting Wire Co. 22
Moore, A. F. 1
Morse Twist Drill & Machine Co. ..
Mossberg & Granville Mfg. Co. 70
Munroe, Hall & Hopkins 55
Munsell & Co., Eugene 35

National Brass & Iron Works 15
National Battery Co. 39
National Carbon Co. 21
National Conduit & Cable Co. 1
National India Rubber Co. 1
Nernst Lamp Co. .....
New England Elec. Mfg. Co. .....
New England Motor Co., The..... 67
New Excelsior Dry Battery Co.,N.Y.
New Process Rawhide Co., The.... 60
New York & Ohio Co. 1
New York Central R. R. 52
New York Insulated Wire Co. 1
New York Safety Steam Power Co. 77
New York Telephone Co. 55
Niles Tool Works Co. .....
North Electric Co. 58
Northern Electrical Mfg. Co. .....
Northern Eng'g Wks. 69

Ohio Electrical Works 19
Okonite Co., Ltd., The 1
Olmsted, L. H. 72
Osburn Flexible Conduit Co..... 46
Ostrander & Co., W. R. 15

Continued on Page 56



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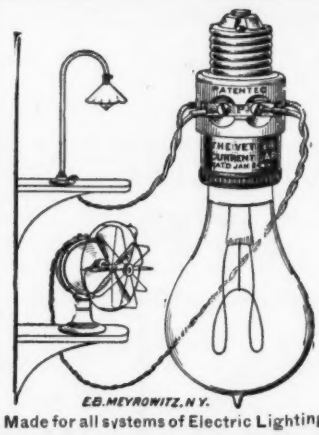

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ALPHABETICAL INDEX TO ADVERTISERS. —*Continued from Page 34.*

Otis Elevator Co. 23
Otto Gas Engine Works 53

Paiste Co., H. T. 34
Parsell & Weed 80
Pass & Seymour, Inc. 9
Pawling & Harnischfeger 69
Payne & Co., B. W. 50
Pearce, Frederick .....
Peerless Elec. Mfg. Co. 29
Peerless Rubber Mfg. Co. 73
Peirce, Jr., C. L. 59
Pelton Water Wheel Co. 44
Pennsylvania Iron Works Co. 76
Pepper & Register 55
Perfecto Gas & Gasoline Engine Co. ..
Phelan, D. W. 10
Phelps Co., The 21
Philadelphia Machine Screw Works 70
Phillips, E. F. 47
Phillips Insulated Wire Co. 46
Phœnix Glass Co. 1
Phosphor-Bronze Smelting Co. 73
Pierce, Richardson & Neiler 55
Pignolet, Louis M. 4
Pittsburgh Transformer Co. 25
Porter Battery Co. 2
Porter Cedar Co., The 10
Portland Co., The .....
Power Installation Co. 55
Powers Co., The E. L. 55
Pratt & Atkins 55
Pratt & Whitney 72
Process Copper and Brass Co. 2
Proposals ..... 52 and 53
Providence Engineering Works .....
Pullen Elec. Co., Leon W. .....

Queen & Co., Inc. 4
Quimbly, Wm. E., Inc. 72

Railways & Light Co. of America 60
Reading Gas & Elec. Fixture Co. 15
Reid, Thoburn 55
Reisinger, Hugo .....
Renim Specialty Co. 28
Reuterdahl Electric Co. 12
Reynolds Electric Flasher Mfg. Co. 19
Ridgway Dynamo & Engine Co. 75
Rittenhouse-Miller Co., The 16
Robbins & Myers Co., The 66
Roberts Electric Supply Co., H. C. 36
Robertson & Son, James L. .....
Robins Conveying Belt Co. 68
Roche, Wm. 13
Rochester Machine Tool Works, Ltd. ..
Rockwood Mfg. Co. 74
Roebling's Sons Co., John A. 16
Roessler & Hasslacher Chemical Co. 13
Rooney-Westbury Elec. Lamp Co. 46
Rosenbaum, W. A. 47
Rosenberg Co., A. 11
Rosenthal's Sons Co., Jos. 50
Rossiter, MacGovern & Co. 51
Roth Bros. & Co. .....
Runyon, F. O. .....
Rushmore Dynamo Works 16
Russell-Tomlinson Electric Co. 59
Ryle & Co., William 17

Safety Insulated Wire & Cable Co. 16
Samson Cordage Works 46
Sangamo Elec. Co. .....
Sargent & Lundy 55
Sauter Electrical Works 27
Sawyer-Man Electric Co. 78
Schaeffer & Budenberg Mfg. Co., The 73
Scheeffer Instrument Co. 4
Schieren & Co., Chas A. 1
Schmidt Tel. Mfg. Co., The Lambert ..
Schoonmaker, A. G. Co. 50
Schoonmaker, A. O. 2
Schott, W. H. 55
Schureman & Hayden 50
Schwerdtle Stamp Co. 52
Scranton Fire Brick & Cond Co. 16
Sears, Henry D. 46
Sebastian Lathe Co. .....
S. E. I. Co. 47
Seneca Falls Mfg. Co. 71
Sheatt & Jaastad 55
Sheeler-Hemsher Co. 17
Shelby Elec. Co. 21
Shultz Belting Co. 1
Siegrist Lubricating Co. .....
Signaloid Chemical Co. 44
Sills-Eddy Mica Co. 80
Simplex Electrical Co. 1
Skinner Eng. Co. .....
Smith, Hemenway & Co., Corp. 58
Smith Co., S. Morgan 45
Smith Storage Battery Co. 12
Southwark Fdry & Mach. Co. 77
Standard Elec'l Mfg. Co., The 28
Southworth & Hare 52
Sprague Electric Co. 14
Standard Paint Co., The .....
Standard Pole & Tie Co., The 10
Standard Telephone & Electric Co. .. 55
Standard Underground Cable Co. ....
Standard Varnish Works 7
Standard Vitrified Conduit Co. 17
Stanley Elec. Mfg. Co. 61
Stanley Instrument Co. 7
Stanton, Le Roy W. 55
Station Equipment Co. 50
Sterling & Son, W. C. 10
Sterling Electric Co. .....
Sterling Electrical Mfg. Co., The 26
Sterling Varnish Co. 46
Stern, Philip K. 55
Sterrett Pump Co. 75
Steward Mfg. Co., D. M. 44
Stewart & Co., F. H. 19
Stewart & Co., John A. 50
Stilwell-Bierce & Smith-Vaile Co. 45
Storage Battery Supply Co. 15
Storey Motor & Electric Co. .....
Stow Mfg. Co. 71
Straley, Hasbrouck & Schloeder 54
Strock, S. C. 10
Stromberg-Carlson Teleph. Mfg. Co. .. 58
Stuart-Howland Co. 28
Sturgess Governor Eng'g Co. .....
Sturtevant Co., B. F. 67
Sunlight Lava Mfg. Co. .....

Thistlewhite, Rob't 52
Thomas & Sons Co., R. 21
Thompson & Leaver Elec. Wks 54
Thompson Son & Co. 49
Toerring Co., C. J. 46
Toomey, Frank 52
Townsend & Decker 47
Tri-Light Elec. Co. 19
Triumph Elec. Co. 34
Trumbull Elec. Co. .....

Union Hardware Co. 21
Union Steam Specialty Co. 73
U. S. Battery Co. 27
United Telpherage Co. .....
United Elec. Heating Co. .....
Utica Drop Forge & Tool Co. 58

Valentine Clark Co., The 10
Vallee Bros. Elec'l Co. 27
Vance, T. D. .....
Van Dorn-Elliott Electric Co. 54
Van Nostrand Co., D. .....
Varley Duplex Magnet Co. 58
Veeder Mfg. Co., The 52
Viaduct Co., The 58
Victor Telephone Works 58
Vilter Mfg. Co. 55
Vitro-Chrome Chemical Co. 80
Vose, Ralph 52
Vulcanized Fibre Co. 16

Wagner, Herbert A. 55
Wagner Elec. Mfg. Co. 63
Wagor Mfg. Co., The P. R. 19
Walsh's Sons & Co. 53
Want and For Sale Ads ..... 48 to 52
Ward Leonard Elec. Co. ..... 19, 21, 23, 25 and 27
Warren Elec. Mfg. Co. 61
Waterbury Machine Co. .....
Watson-Stillman Co. 70
Western Electrical Supply Co. ..22 and 24
Westinghouse, Church, Kerr & Co. 79
Westinghouse Elec. Mfg. Co. 79
Westinghouse Mach. Co. 79
Weston Elect. Inst. Co. 4
Western Electric Co. 5
Wheeler Reflector Co. 43
White & Co., J. G. 55
Whitehead Machinery Co. 50
Whitted, Thos. B. 55
Whitney Elec. Inst. Co. 35
Wisconsin Graphite Co. .....
Willard Storage Battery Co. 12
Willyoung, Elmer G. 3
Wirt Electric Co. 37
Wood & Son, R. D. 53
Woodward & Rogers Co., The 71
Woodward Governor Co. .....
Worcester Co., C. H. 10
Wyckoff, Seamans & Benedict .....

Xylotite Mfg. Co., The 65

Yale & Towne Mfg. Co., The 69
Zimdars & Hunt 13

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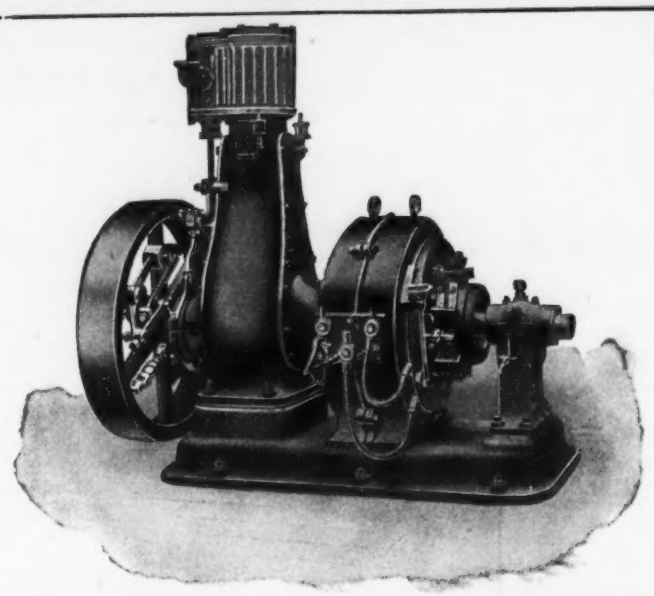

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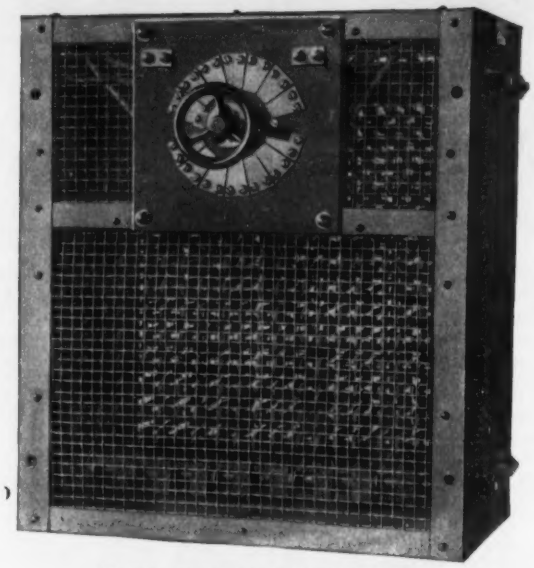

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Dyke, A. L.
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Bunnell & Co., J. H.
Edison Mfg. Co.
Electric Gas Lighting Co.
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BATTERIES, STORAGE.
American Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Helios-Upton Co.
National Battery Co.
Porter Battery Co.
Reuterdahl Electric Co.
Smith Storage Battery Co.
United States Battery Co.
Willard Storage Battery Co., The.

BELLS.
Edwards & Co.
Ostrander & Co., W. R.
Viaduct Mfg. Co.

BELTING.
Graton & Knight Mfg. Co.
Schieren & Co., Chas. A.
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BLOWERS.
Buffalo Forge Co.
Sturtevant Co., B. F.

BOILERS.
Babcock & Wilcox Co., The.
Illinois Maintenance Co.
New York Safety Steam Power Co.
Smith Co., S. Morgan.

BOILER CLEANERS.
Mechanical Boiler Cleaner Co.

BOILER COMPOUNDS.
Dearborn Drug & Chemical Works.

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BOOKS, TECHNICAL.
ELECTRICAL WORLD AND ENGINEER.
Inland Printer Co., The.
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CABLE CONNECTIONS.
New Haven Novelty Mch. Co., The.

CABLE HANGERS.
Chase-Shawmut Co.
Johns-Manville Co., H. W.
Standard Underground Cable Co.

CAR HEATERS, ELECTRIC.
Johns-Manville Co., H. W.
Simplex Electrical Co.

CAR LIGHTING, ELECTRIC.
Consolidated Railway Electric Lighting & Equipment Co.

CARBON POINTS AND PLATES.
Consumers Carbon Co.
Dickey-Sutton Carbon Co., The.
Eastern Carbon Works.
National Carbon Co.
Reisinger, Hugo.

CASTINGS.
Christensen Engineering Co.
Dyke, A. L.
Graves Motor Mfg. Co.
Process Copper & Brass Co.
Sheeler-Hemsher Co.
Smith Co., S. Morgan.

CELLS.
Electric Gas Lighting Co.

CHAIN BLOCKS.
Yale & Towne Mfg. Co., The.

CIRCUIT BREAKERS.
Carpenter Enclosed Resistance Co.
Condit, Jr., & Co., S. B.
Cutler-Hammer Mfg. Co.
Cutter Electrical & Mfg. Co.
Ft. Wayne Electric Wks.
La Roche Co., F. A.
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Kilbourne & Clark Co., The.

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Hubbell, Harvey.

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Signaloid Chemical Wks.

COMMUTATORS.
Elliott Bros. Elec. Co., The.
Heck, Louis.
Homer Commutator Co.
VanDorn, Elliott Elec. Co.

COMMUTATOR COMPOUND.
Ashmore & Co., E. M.
Diamond Chemical Wks.
Dixon Crucible Co., Joseph.
K. & W. Co.
McLennan Co., K.
Southwarth & Hare.

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Alberger Condenser Co.
Conover Mfg. Co.
Marshall, Wm. (Electric).
Stanley Elec. Mfg. Co. (Electric).
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CONDUITS.
Alphaduct Mfg. Co.
American Interior Conduit Co.
American Vitrified Conduit Co.
Camp Co., The H. B.
Electrolysis Proof Conduit Mfg. Co.
Harrington, C. J.
National Conduit & Cable Co.
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Scranton Fire Brick and Conduit Co.
Sprague Electric Co.
Standard Underground Cable Co.
Standard Vitrified Conduit Co.

CONDUIT BENDER.
Benson & Co., W. W.

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McIntire Co., The C.
Smith, Hemenway & Co. Corp.
Utica Drop Forge & Tool Co.

CONSTRUCTION SUPPLIES.
Peirce, Jr., C. L.

CONSTRUCTION TOOLS.
Cincinnati Tool Co.
Farr Telephone & Const. Supply Co.
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Smith, Hemenway & Co., Corp.
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Aultman Co., The.
Brown Hoisting Mchy. Co., The.
Case Mfg. Co.
Hunt Co., C. W.
Jeffrey Mfg. Co.
Link-Belt Engineering Co.
Maris Bros.
Mead Mfg. Co., John A.
Niles Tool Works Co.
Pawling & Harnischfeger.
Robins Conveying Belt Co.
United Telpherage Co.

COOLING TOWERS.
Alberger Condenser Co.

COPPER.
Process Copper & Brass Co.

CORD ADJUSTERS.
Stewart & Co.
Frank H. Crescent Co., The.

CORD ARC LAMP.
Samson Cordage Wks.

CORD, FLEXIBLE.
American Elecl. Wks.
American Steel & Wire Co.
Moore, Alfred F.

CORD, TROLLEY.
Samson Cordage Wks.

COUNTING MACHINES.
Veeder Mfg. Co., The.

CRANES, TRAVELING.
Brown Hoisting Mch. Co., The.
Maris Bros.
Niles Tool Works Co.
Northern Engineering Works.
Pawling & Harnischfeger.
Yale & Towne Mfg. Co.

CREOSOTING.
American Creosote Works.

CROSS ARMS.
Central Mfg. Co.
Eccleston Lumber Co.
Locke, Fred M.
Standard Pole & Tie Co., The.
Sterling & Son, W. C.

CURRENT TAPS.
Dale Co., The.
Meyrowitz, E. B.

CUT-OUTS.
Abbott, Eugene B.
D. & W. Fuse Co.
Fort Wayne Electric Works.
New England Elec. Mfg. Co.
Pass & Seymour, Inc.
Trumbull Elec. Co.

CUTTING TOOLS.
Mendes Cutting Factories.

DESK LAMPS.
Dale Co., The.
McLeod, Ward & Co.

DIAMOND TOOLS.
Mendes Cutting Factories.

DRILLS, PORTABLE.
Stow Mfg. Co.

DRILL GRINDERS.
Heald & Son, L. S.
Morse Twist Drill & Machine Co.
Pratt & Whitney Co.

DYNAMOS AND MOTORS.
Akron Elect. Mfg. Co.
American Engine Co.
Bullock Electric Mfg. Co.
Carlisle & Finch Co., The.

Continued on Page 38.

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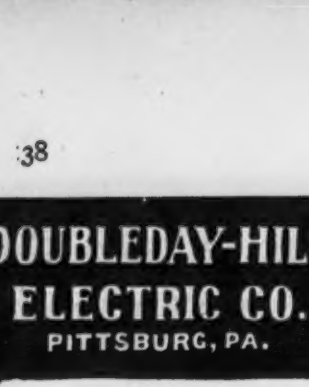

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PITTSBURG, PA.

CLASSIFIED INDEX.—*Continued from Page 37.*

C. & C. Electric Co.
Christensen Engr. Co.
Cincinnati Elec. Mtr. Co.
Commercial Electric Co.
Conn. Dynamo & Elec. Co.
Crocker-Wheeler Co.
Eck Dynamo & Motor Works.
Electric Machinery Co.
Electro-Dynamic Co.
Elwell-Parker Electric Co.
Emerson Electric Mfg. Co.
Federal Elec. Co.
Ft. Wayne Electric Works.
Fuller Co., The.
General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Hanson & Van Winkle Co., The.
Holtzer-Cabot Elec. Co.
Illinois Maintenance Co.
Jeffrey Mfg. Co.
Jenney Elec. Mfg. Co.
Keystone Electric Co., The.
Kilbourne & Clarke Co., The.
Lincoln Electric Co.
Mayer Electric Co., M. M.
Mechanical Appliance Co.
New England Motor Co., The.
Northern Electrical Mfg. Co.
Parsell & Weed.
Payne & Co., B. W.
Ridgway Dynamo & Engine Co.
Robbins & Myers Co., The.
Rossiter, MacGovern & Co.
Roth Bros. & Co.
Rushmore Dynamo Works.
Schoonmaker Co., A. G.
Sprague Electric Co.
Stanley Elec. Mfg. Co.
Stow Mfg. Co.
Sturtevant Co., B. F.
Thompson, Son & Co.
Triumph Elec. Co.
Wagner Elec. Mfg. Co.
Warren Electric Mfg. Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC CARRIAGE CALLS.
Edwards & Co.

ELECTRIC HEATING DEVICES.
American Electrical Heater Co.
Johns-Manville Heater Co.
Kilbourne & Clark Co., The.
Simplex Electrical Co.
United Electric Heating Co.

ELECTRICAL LAUNCHES.
Electric Launch Co.

ELECTRIC LEATHER BELTING.
Schieren & Co., Chas. A.

ELECTRIC MINE LOCOMOTIVES.
Jeffrey Mfg. Co.

ELECTRIC NOVELTIES.
Carlisle & Finch Co.
Knapp Elec. & Novelty Co.
Ohio Electric Works.

ELECTRIC SIGNS.
Federal Elec. Co.
Goltz Eng'r Company.

ELECTRICAL INSTRUMENTS.
Biddle, James G.
Bunnell & Co., J. H.
Cutter Elect'l & Mfg. Co.
Diamond Meter Company.
Duncan Elec. Mfg. Co.
Eldredge Electric Mfg. Co.
Empire Electrical Inst. Co.
Ft. Wayne Electric Works.
General Incandescent Arc Light Co.
Gregory Electric Co.
Jewell Electrical Instrument Co.
Keystone Elec'l Instrument Co.
Machado & Roller.
Northern Elec'l Mfg. Co.
Pignolet, Louis M.
Queen & Co., Inc.
Sangamo Electric Co.
Scheeffer Instrument Co.
S. E. I. Co.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Elec. Mfg. Co.
Westinghouse Electric & Mfg. Co.
Weston Electrical Inst. Co.
Whitney Electrical Inst. Co.
Willyoung, Elmer G.

ELECTRICAL TESTING.
Lamp Testing Bureau.

ELECTROMAGNETS.
Varley Duplex Magnet Co.

ELECTROPLATING DYNAMOS.
Conn. Dynamo & Elec. Co.
Hanson & Van Winkle Co., The.

ELEVATORS.
Aultman Co., The.
Link-Belt Engineering Co.
Otis Elevator Co.

ENGINEERS AND CONTRACTORS.
Arnold Electric Power Station Co.
Associated Engineering Co., The.
Baker, Joseph B.
Baker & Co., W. E.
Ballantyne & Evans.
Barstow, W. S.
Benson, D. L.
Burch, Edward P.
Burgess, C. F., E. E.
Cahoon, James Blake.
Coho & Co., H. B.
Collins, Frederick A.
Doble, Robert McF.
Felt & Co., Charles E.
Ford, Bacon & Davis.
Fuller Co., The.
Gest, G. M.
Hartford & Co.
Heck, Louis.
Hering, Carl.
Horry, Wm. Smith.
Humphrey, Henry H.
Hutton Eng. Co., The.
Kilbourne & Clark Co.
Knowles, Edward R.
Kohler Bros.
Mailloux, C. O.
Munroe, Hall & Hopkins.
Pepper & Register.
Pierce, Richardson & Neiler.
Power Installation Co.
Pratt & Atkins.
Railways & Light Co., of America.
Reid, Thoburn.
Runyon, F. O.
Sargent & Lundy.
Schott, M. H.
Sheaff & Jaastad.
Stanley Elec. Mfg. Co.
Stanton, Le Roy W.
Stern, Philip K.
Wagner, Herbert A.
Westinghouse, Church, Kerr & Co.
White & Company, J. G.
Whitted, Thomas B.

ENGINES, GAS AND GASOLINE.
Lowell Model Works.
Marinette Iron Works Mfg. Co.
Mietz, A.
Otto Gas Engine Works.
Parsell & Weed.
Perfecto Gas & Gasoline Eng. Co.
Westinghouse Machine Co.
Wood & Son, R. D.

ENGINES, OIL.
Mietz, A.

ENGINES, STEAM.
Allis-Chalmers Co.
American Engine Co.
Ball Engine Co.
Buffalo Forge Co.
Frick Co. (Corliss and Automatic).
Fuller Co., The.
Harrisburg Foundry & Mch. Works.
Ide & Sons, A. L.
Illinois Maintenance Co.
Leffel & Co., James.
McIntosh, Seymour & Co.
New York Safety Steam Power Co.
Pennsylvania Iron Works Co.
Providence Engineering Works.
Ridgway Dynamo & Engine Co.
Rochester Machine Tool Co.
Skinner Engine Co.
Southwark Foundry & Mach. Co.
Sturtevant Co., B. F.
Vilter Mfg. Co.
Westinghouse Machine Co.

ENGINE STOPS.
Consolidated Engine-Stop Co.

EXHAUST HEADS.
Burt Mfg. Co.

FANS AND FAN MOTORS.
Bates & Bro., D. L.
Buffalo Forge Co.
Central Electric Co.
Dayton Fan & Motor Co.
Diehl Mfg. Co.
Doubleday-Hill Elec. Co.
Emerson Elec. Mfg. Co.
Ft. Wayne Electric Works.
Fuller Co., The.
General Elec. Co.
Gen. Inc. Arc Lt. Co.
Holtzer-Cabot Elec. Co.
Illinois Maintenance Co.
Peerless Elec Mfg. Co.
Robbins & Myers Co., The.
Rosenberg Co., A.
Sprague Electric Co.
Stuart-Howland Co.
Sturtevant Co., B. F.
Western Electric Co.

FEED WATER HEATERS.
Illinois Maintenance Co.
Stilwell-Bierce & Smith-Vaile Co., The.

FIBRE.
Delaware Hard Fibre Co.
Kartavert Mfg. Co., The.
Vulcanized Fibre Co.

FILES, RASPS, ETC.
Barnett Co., G. & H.

FIRE PROTECTORS.
American Thermo Call Co.
Montauk Fire Detecting Wire Co.

FIXTURES (Gas & Electrical).
Benjamin Elec. Mfg. Co.
Dale Co., The.
Faries Mfg. Co.
Geis & Co., Wm. V.
Kilbourne & Clark Co.
Reading Gas & Elec. Fixture Co.

FLASHERS.
Reynolds Elec. Co.

FLEXIBLE SHAFTS.
Stow Mfg. Co.

FORGES.
Buffalo Forge Co.
Sturtevant Co., B. F.

FUEL ECONOMIZERS.
Green Fuel Economizer Co.

FUSES.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Co.
Johns-Manville Co., H. W.
McIntire Co., The C.

GAUGES, STEAM.
Crosby Steam Gage & Valve Co.
Robertson & Sons, Jas. L.

GAS LIGHTING APPARATUS.
Electric Gas Lighting Co.
Ostrander & Co., W. R.
Roche, Wm.

GLOBES, SHADES, ETC.
Century Glass Co.
Faries Mfg. Co.
Frink, I. P.
Holophane Glass Co.
Phœnix Glass Co.
Wheeler Reflector Co.

Continued on page 40.

GEARS.
New Process Raw Hide Co., The.
Smith Co., S. Morgan.

GRAPHITE.
Dixon Crucible Co., Jos.

GREASE.
Dixon Crucible Co., Jos.
Wisconsin Graphite Co.

GUY ANCHORS.
Matthews & Bro., Wm. N.

HACK SAWS.
Olmstead, L. H.

HANGER BOARDS.
K. & W. Co.

HEATING APPARATUS.
Buffalo Forge Co.
Sturtevant Co., B. F.

HEATING BY EXHAUST STEAM.
American District Steam Co.

HOISTS.
Brown Hoisting Mch. Co.
Case Mfg. Co.
Jeffrey Mfg. Co.
Pawling & Harnischfeger.
United Telpherage Co.

HOISTING CRABS, SAFETY.
Yale & Towne Mfg. Co., The.

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Electric Gas Lighting Co.

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Pelton Water Wheel Co.

ICE MAKING MACHINERY.
Vilter Mfg. Co.

IGNITERS, GAS ENGINE.
Carlisle & Finch Co., The.
Holtzer-Cabot Elec. Co.

INDICATORS.
Robertson & Sons, Jas. L.
Union Steam Specialty Co.

INDUCTION COILS.
International Brass & Elec. Co., Inc.
Ostrander & Co., W. R.
Varley Duplex Magnet Co.

INSTRUMENTS (Testing and Recording).
Biddle, James G.
Bristol Co.
Cutter Elec'l & Mfg. Co.
Diamond Meter Co.
Duncan Elec. Mfg. Co.
Empire Electrical Inst. Co.
Foote, Pierson & Co.
Ft. Wayne Electric Works.
General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Illinois Electrical Specialty Co.
Jewell Electric Instrument Co.
Lamp Testing Bureau.
Machado & Roller.
Olivette, C.
Queen & Co.
Schaffer & Budenberg Mfg. Co., The.
S. E. I. Co.
Stanley Instrument Co.
Vose, Ralph.
Wagner Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.
Weston Electrical Inst. Co.
Whitney Electrical Instrument Co.
Willyoung, Elmer G.

INSULATORS AND INSULATING MATERIAL.
American Steel & Wire Co.
Anderson Mfg. Co., A. & J. M.
Bellevue Porcelain Works.
Carpenter Enclosed Resistance Co.
Crescent Insulated Wire & Cable Co.
Delaware Hard Fibre Co.
Dickinson Hard Rubber Co.
Empire China Works.
Ft. Wayne Electric Works.
Harrington, C. J.
Hartford Faience Co., The.
Hemingray Glass Co.
Insulating Saddle Staple Co.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Locke Insulator Mfg. Co.
Lovell & Co., F. H.
Mica Insulator Co.
Munsell & Co., Eugene.
Pass & Seymour, Inc. (China).
Ryle & Co., Wm. (Silk).
Safety Insulated Wire & Cable Co., The.
Standard Paint Co.
Standard Underground Cable Co.
Standard Vitrified Conduit Co.
Sterling Varnish Co.
Steward Mfg. Co., D. M.
Sunlight Lava Mfg. Co., R.
Thomas & Sons Co., R.
Union Hardware Co.
Vulcanized Fibre Co.
Ward Leonard Electric Co.
Xylotite Mfg. Co., The.

JACKS.
Watson-Stillman Co.

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General Incandescent Arc Light Co.
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Columbia Elec. & Mfg. Co.
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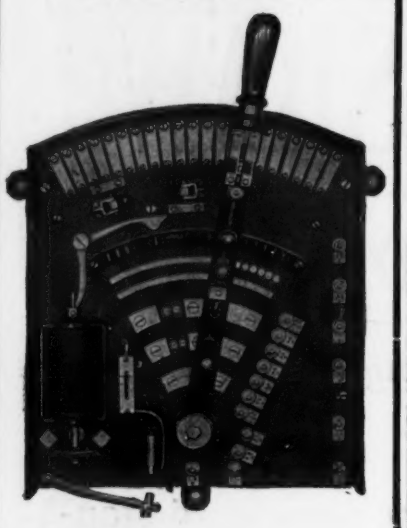

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CLASSIFIED INDEX.—*Continued from Page 38.*

Western Electrical Supply Co.
Westinghouse Electric & Mfg. Co.

LAMPS, INCANDESCENT.
Banner Elec. Mfg. Co.
Capital Electric Co.
Columbia Inc. Lamp Co.
Economical Electric Lamp Co.
Edison Dec. & Min. Lamp Dept.
Franklin Electric Mfg. Co., The.
General Electric Co.
General Incandescent Arc Light Co.
Helios-Upton Co.
Lamp Testing Bureau.
Machado & Roller.
New York & Ohio Co.
Phelps Co., The.
Pittsburgh Incandescent Lamp Co.
Sawyer-Man Electric Co.
Shelby Electric Co.
Standard Electric Mfg. Co.
Sterling Electrical Mfg. Co., The.
Tri-Light Elec. Co.
Western Electric Co.

LAMP CORD ADJUSTER.
Incan. Electric Lt. Manip. Co.

LAMP GUARDS.
Wager Mfg. Co., P. R.

LAMPS, MINIATURE.
Edison Dec. & Min. Lamp Co.
Jaeger Min. Lamp Co.
McCandless, H. W.
Rooney-Westbury Elec. Lamp Co., The.

LAMPS, NERNST.
Nernst Lamp Co.

LAMPS, REGULATING.
Economical Electric Lamp Co.
Tri-Light Electric Co.

LAMP REPLACER.
Incan. Electric Lt. Manip. Co.

LATHES.
Barnes Co., W. F. & John.
Hardinge Bros.
Sebastian Lathe Co.
Seneca Falls Mfg. Co., The.

LEAD.
Colwell Lead Co.

LINEMEN'S TOOLS.
Cincinnati Tool Co.
Smith & Hemenway Co.
Utica Drop Forge & Tool Co.

LIGHTNING ARRESTERS.
Cook, Frank B.
D. & W. Fuse Co.
Garton-Daniels Co.
Stanley Elec. Mfg. Co.
Viaduct Mfg. Co.
Westinghouse Elec. & Mfg. Co.

LUBRICANT.
Wisconsin Graphite Co.

LUBRICATORS.
Crane Co., The.
Lunkenheimer Co., The.
Siegrist Lubricator Co.

MACHINE TOOLS, ETC.
Barnes Co., W. F. & John.
Bement, Miles & Co.
Besly & Co., Charles H.
Bliss Co., E. W.
Chapin-Love Machine Co.
Cincinnati Milling Machine Co.
Cincinnati Planer Co.
Dreses Mach. Tool Co.
Garvin Machine Co.
Hardinge Bros.
Heald & Son, L. S.
Long & Allstatter Co., The.
Mossberg & Granville Mfg. Co.
Niles Tool Works Co.
Philadelphia Machine Screw Works.
Pond Machine Tool Co.
Pratt & Whitney Co.
Sebastian Lathe Co.
Seneca Falls Mfg. Co.
Waterbury Mch. Co.
Watson-Stillman Co.
Woodward & Rogers Co.

MARINE ELECTRIC EQUIPMENT.
Electro-Dynamic Co.
Kilbourne & Clark Co., The.

MAST ARMS.
Brady, T. H.
Creaghead Eng'g Co.

MECHANICAL DRAFT.
Sturtevant Co., B. F.

MEDICAL APPARATUS.
Pignolet, Louis M.

METAL LETTERS.
Goltz Eng'r Company.

METAL POLISH.
Hoffman, George W.

MICA.
Asheville Mica Co.
Burleson Mica Co., J. E.
Johns-Manville Co., H. W.
Mica Insulator Co.
Munsell & Co., Eugene.
Schoonmaker, A. O.
Sills-Eddy Mica Co.
Vance, D. T.

MILLING MACHINES.
Becker-Brainard Milling Machine Co.
Cincinnati Milling Machine Co.
Dreses Mach. Tool Co.
Garvin Machine Co., The.
Heald & Son, L. S.
Niles Tool Works Co.
Pratt & Whitney Co.

MINING MACHINERY.
General Electric Co.
Jeffrey Mfg. Co., The.

MODEL MAKERS.
Baillard, E. V.
Balkwill Pattern Works, The.
International Brass & Electric Co., Inc.
Kleinschmidt, E.
Louis Mfg. Co.
Parsell & Weed.
Pearce, Frederick.

MOTOR CLOTH AND INSULATING PAPERS.
Standard Paint Co.

NAME PLATES.
Becker Eng. Co., A.
Murdock Parlor Grate Co.

NIPPERS AND PLYERS.
Cincinnati Tool Co.
Smith, Hemenway & Co., Corp.
Utica Drop Forge & Tool Co.

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Becken, A. C.

NUTS.
International Brass & Elec. Co.

OIL AND GREASE CUPS.
Besly & Co., Charles H.
Crane Co., The.
Lunkenheimer Co., The.

OILS, CYLINDER.
Kellogg & Co., E. H.

OIL FILTERS AND PURIFIERS.
Burt Mfg. Co.

OUTLET BOXES.
Renim Specialty Co.

OVERHEAD RAILWAYS.
United Telpherage Co.

PACKING.
Jenkins Bros.
Johns-Manville Co., H. W.
Peerless Rubber Mfg. Co.
Robertson & Sons, James L.

PAINTING MACHINES.
Hook, F. E.

PAINTS, VARNISHES, ETC.
Hook, F. E.
Standard Paint Co.
Standard Varnish Works.
Sterling Varnish Co.

PATENT ATTORNEYS.
Byrnes & Townsend.
Crompton, Faust S.
Dyer, Edmonds & Dyer.
Freer & Partlow.
Goepel & Niles.
Johnson, Thomas J.
Rosenbaum, Wm. A.
Straley, Hasbrock & Schloeder.
Townsend & Decker.

PHOTOMETER STANDARDS.
Lamp Testing Bureau.

PHOSPHOR BRONZE.
Phosphor Bronze Smelting Co.

PINIONS.
New Process Raw Hide Co.

PIPE JOINT PASTE.
Wisconsin Graphite Co.

PLATINUM.
Baker & Co.
Croselmire, C. F.
Croselmire & Ackor.

POLES, TIES, BRACKETS, PINS, ETC.
Brady, T. H.
Central Mfg. Co.
Creaghead Eng'g Co.
Eccleston Lumber Co.
Maltby Lumber Co.
Phelan, D. W.
Porter Cedar Co.
Standard Pole & Tie Co., The.
Sterling, W. C., & Son.
Strock, S. C.
Worcester Co., C. H.

PORCELAIN ENAMEL.
Krantz Mfg. Co., H.

PORCELAIN MANUFACTURERS.
Bellevue Porcelain Works.
Empire China Works.
Hartford Faience Co., The.
Locke, Fred M.
Pass & Seymour, Inc.
Thomas & Sons Co., R.

POWER TRANSMISSION MACHINERY
American Pulley Co.
Aultman Co., The.
Brown Hoisting Machy. Co., The.
Jeffrey Mfg. Co.
Hunter Machine Co., The James.
Link-Belt Engineering Co.
Niles Tool Works Co.
Siemens Bros. & Co., Ltd.

PRESSES, DIES AND SPECIAL MACHINERY.
Bement, Miles & Co.
Bliss Co., E. W.
Hunter Machine Co., The James.
Pond Machine Tool Co.
Watson-Stillman Co.

PULLEYS, SHAFTING, COUPLINGS, ETC.
American Pulley Co.
Aultman Co., The.
Hunter Machine Co., The James.
Jeffrey Mfg. Co.
Niles Tool Works Co.
Rockwood Mfg. Co.
Smith Co., S. Morgan.
Xylotite Mfg. Co., The.

PUMPS, ELECTRIC.
Commercial Electric Co.
Emerson Elec. Mfg. Co.
Quimby, Wm. E.

PUMPS, OIL.
Goulds Mfg. Co.
Sterrett Pump Co.

PUMPS, POWER.
Goulds Mfg. Co.

PUMPS, STEAM.
McGowan Co., The J. H.
Quimby, Wm. E.
Stilwell-Bierce & Smith-Vaile Co., The.
Union Steam Specialty Co.

PUMP VALVES, RUBBER.
Crosby Steam Gage and Valve Co.

PUNCHES AND SHEARS.
Bliss Co., E. W.
Bement, Miles & Co.
Buffalo Forge Co.
Ferracute Machine Co.
Long & Allstatter Co., The.
Pond Machine Tool Co.
Pratt & Whitney Co.

PUSHBUTTONS.
American Push Button Tele. Co.
Union Hardware Co.

RAIL BONDS.
American Steel and Wire Co.
Roebling's Sons Co., J. A.

RAILWAY SUPPLIES (Electric).
Central Electric Co.
General Electric Co.
Harrington, C. J.
Johns-Manville Co., H. W.
Kinsman Elec. & Ry. Supply Co.
Ohio Brass Co.

RAILWAYS (MIN.).
Carlisle & Finch Co., The.

RAWHIDE PINIONS.
New Process Raw Hide Co.

RECEPTACLES.
Benjamin Elec. Mfg. Co.
Dale Co., The.
Electro-Dynamic Co., The.
General Incandescent Arc Light Co.
Paiste Co., H. T.
Trumbull Elec. Co.
Vallee Bros. Elec'l Co.

REFLECTORS.
Dale Co., The.
Frink, I. P.
Phœnix Glass Co.
Wheeler Reflector Co.

REFRIGERATING MACHINERY.
Vilter Mfg. Co.

REPAIRING.
Chicago Edison Co., Repair Shops.
Elliott Bros. Elec. Co., The.
Gregory Electric Co.
Heck, Louis.
Thompson & Leaver Elec. Works.
Van Dorn, Elliott, Electric Co.

RHEOSTATS.
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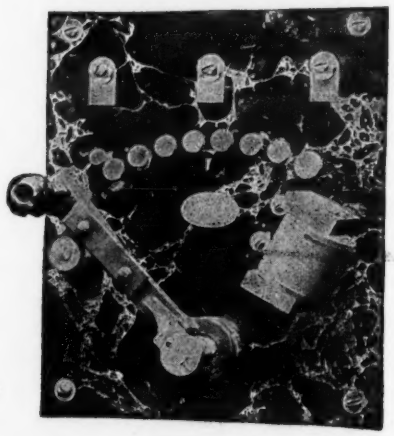

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Electro-Dynamic Co., The.
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Johnson & Morton.
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Keystone Electric Telephone Co.
Krantz Mfg. Co., H.
La Roche Co., F. A.
Liberty Elec'l Supply Co.
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Sterling Electric Co.
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Bissell & Co., The F.
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Central Electric Co.
Chase-Shawmut Co.
Condit, Jr., & Co., S. B.
Cook, Frank B.
Crouse-Hinds Electric Co.
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Electric Dynamic Co., The.
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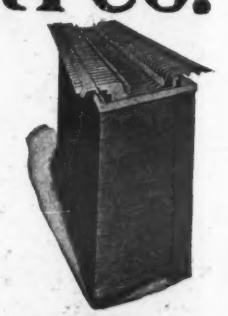

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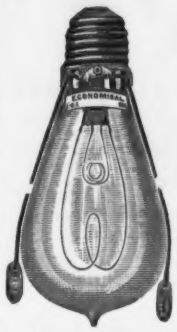

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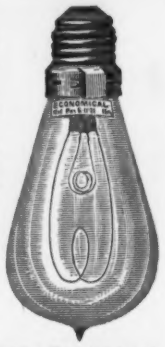

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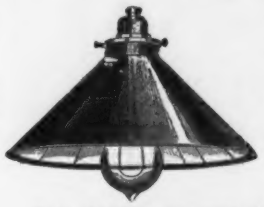

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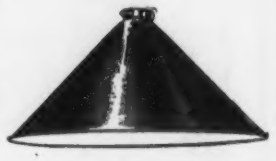

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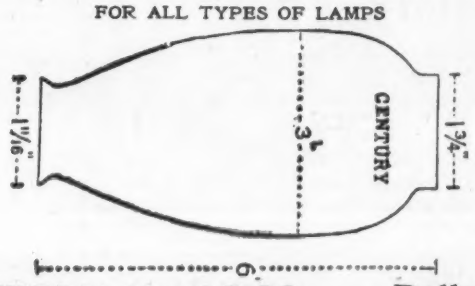

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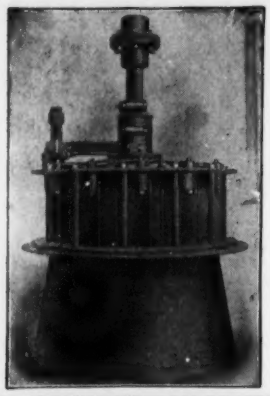

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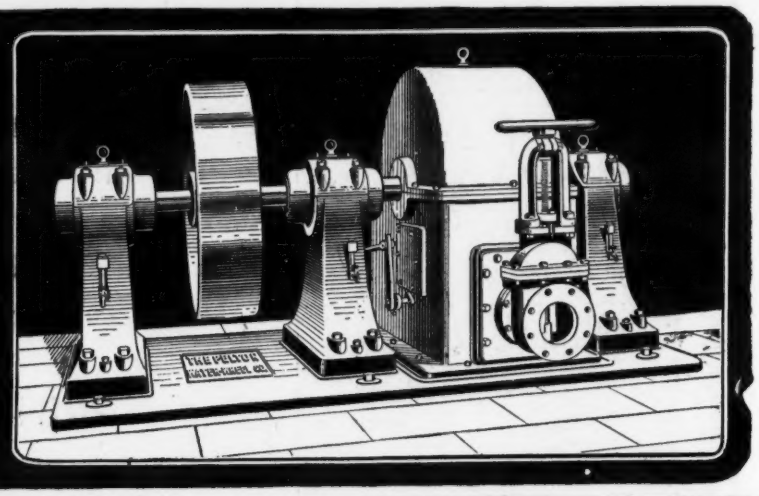

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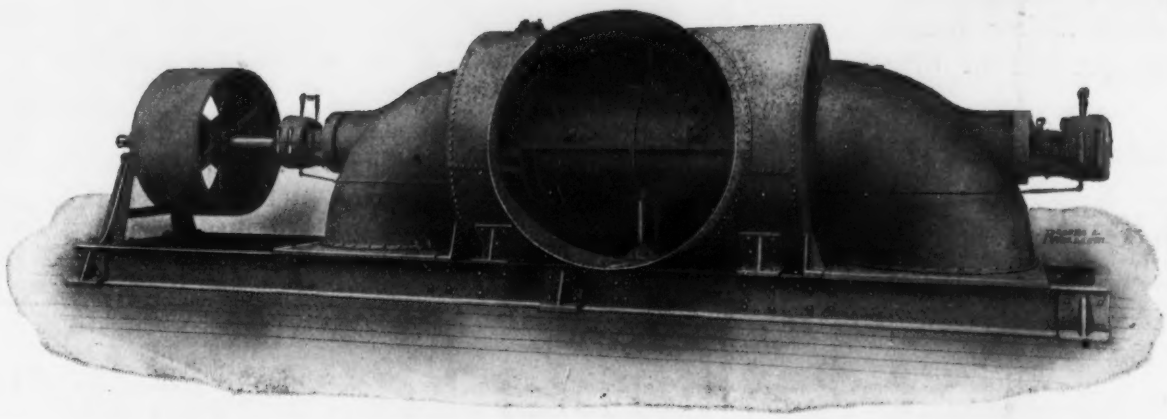

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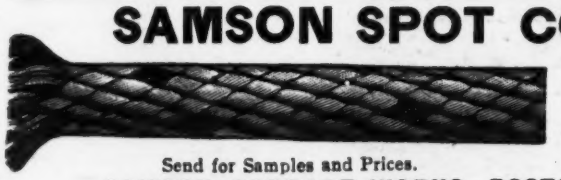

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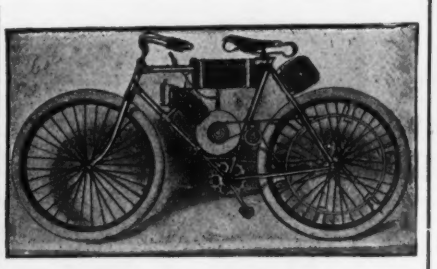
FOR CARD INDEX
ELECTRICAL WORLD AND ENGINEER, DEC. 20, 1902

The Sleet Break-Down of the Manhattan System	992
International Congresses at the St. Louis World's Fair	992
Ruhmer's Photoelectric Telephone. By A. Frederick Collins	993
Some Notes on Illumination. By Bassett Jones, Jr.	995
Telephone Cables—III. By Arthur V. Abbott, C. E.	996
French System of Train Lighting. By P. Letheule	999
A Theory of Magnetism. By Johannes Zacharias	1000
The Production of Calcium and Strontium. By H. Danneel	1002
The Armature Reaction of Alternators—VII. By C. F. Guilbert	1003
Changes in the National Electric Code	1006
Telephone Law in Ohio	1007
Pro and Con of Interurban Trolleys	1007
Letter Boxes on Trolley Cars	1008
A New Trolley Bridge for Greater New York	1008
The Size of Atoms. By H. V. Ridout	1009
Digest of Current Electrical Literature	1010
Surface Electric Locomotives	1013
The Moore System of Vacuum-Tube Lighting	1015
Large Electric Crane in Railroad Shops	1016
Moonlight Tables for 1903	Supplement



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(*Continued on page 52.*)

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1—12-K.W. Eddy.
1—15-K.W. Triumph, multipolar.
1—20-K.W. Bullock, multipolar.
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1—30-K.W. Edison, compound.
1—45-K.W. Edison, compound.
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1—33-K.W. Wood, multipolar.
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1—35-K.W. Bullock, multipolar.
5—45-K.W. Edison, compound.
1—50-K.W. T.-H., D 50, oil cups.
1—60-K.W. Edison, compound.
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2—1500-Lt. Wood, 75-K.W., comp., toothed armature, with exciter.
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1—1-H.P. New England.
1—2-H.P. Jenney.
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2—120-K.W. G. E., 125 cycles, single P.
2—120-K.W. Westinghouse, 125 cycle.
2—75-K.W. Wood, 133 cycles, single P.
2—60-K.W. Stanley, 60 cycles, 2 P.
2—60-K.W. Stanley, 125 cycles, 2 P.
4—60-K.W. G. E., 125 cycles, single P.
2—60-K.W. Westinghouse 125 cycles.
1—35-K.W. Westinghouse, 60 cycles.
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1—10-H.P. Westinghouse, 60 cycles, three phase, 110 volts.
1—10-H.P. Westinghouse, 60 cycles, 3 phase, 220 volts.
1—10-H.P. Westinghouse, 60 cycles, 2 phase, 110 volts.
1—10-H.P. Excelsior, 125 cycles, 110 volts, single phase, Synchronous type.
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1—5-H.P. 60 cycles, 3 phase, 110 volts.
1—5-H.P. 60 cycles, 2 phase, 110 volts.
1—5-H.P. Fort Wayne, single phase, 104 volts, 125 cycles.
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1—60-K.W. Westinghouse, M. P.
2—D, 62-K.W. Thomson-Houston.
2—60-K.W. Edison bi-p[illegible].
2—45-K.W. Edison bi-pol[illegible].
2—30-K.W. Edison bi-polar.
2—25-K.W. Edison bi-polar.
4—20-K.W. Edison bi-polar.
1—22½-K.W. Loomis.
2—20-K.W. Thomson-Houston, type D.
1—12-K.W. Westinghouse, M. P.
1—75-H.P. Eddy M. P. MOTOR.
2—32-H.P. Crocker-Wheeler, M. P.
2—25-H.P. T.H., type D. MOTORS.
1—25-H.P. Claus.
1—15-H.P. Eddy M. P.
1—15-H.P. Edison bi-polar.
1—1-H.P. Crocker Wheeler.

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2—100-K.W. C. & C. M. P.
2—100-K.W. Edison bi-polar.
2—60-K.W. Edison, bi-polar.
1—50-K.W. Fort Wayne, Jenny, M. P.
1—45-K.W. Edison bi-polar.
1—37½-K.W. C. & C., M. P.
1—25-K.W. Edison, bi-polar.
1—12-K.W. Edison, bi-polar.
1—75-H.P. Edison, bi-polar MOTOR.
1—60-H.P. Edison, bi-polar.
1—50-H.P. C. & C., M. P.
1—25-H.P. Sprague, 6 pole.
1—15-H.P. Keystone Elevator type.
1—15-H.P. Edison bi-polar.
2—10-H.P. Crocker Wheeler, M. P.
1—10-H.P. Excelsior.
1—7½-H.P. Sprague.
2—7½-H.P. American Ball, M. P.
1—5-H.P. General Electric.
2—2-H.P. Lundell.

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2—500-K.W. General Electric M. P.
1—150-K.W. Westinghouse, M. P.
2—150-K.W. Edison, bi-polar.
1—120-K.W. C. & C. M.P. (latest type).
2—100-K.W. C. & C. M.P. (latest type).
4—100-K.W. General Electric M P.
2—100-K.W. Edison bi-polar.
2—90-K.W. Thomson-Houston, M. P.
1—75-K.W. Westinghouse, M. P.
2—D, 62-K.W. Thomson-Houston, B.P.
2—60-K.W. Edison bi-polar.
1—50-K.W. Detroit M. P.
2—45-K.W. Edison bi-polar.
1—90-H.P. Bullock M. P. MOTOR.
1—65-H.P. Bullock M. P.
1—60-H.P. Edison bi-polar.
1—40-H.P. Westinghouse M. P.
1—15-H.P. Westinghouse M. P.
1—15-H.P. Edison bi-polar.
1—10-H.P. Eddy B. P.
1—10-H.P. C. & C. M. P.
1—7½-H.P. American Ball M. P.
1—5-H.P. C. & C. M. P.

DIRECT CONNECTED UNITS.

1—525-K.W. G. E. M.P. 550-600 volts, d. c. Allis Corliss engine (new).
1—100-K.W. G. E., M. P. 250 volts d. c. 16½x15 M. P. McI. & S. engine.
2—75-K.W. G. E. M. P. 125 volt, d. c. Ames Tandem Engines.
1—80-K.W. Jenny M. P. 110 volt, d. c. Russell 4 valve engine.
1—50-K.W. Weston Electric M. P. 125 volts d. c. Ball & Wood engine.
1—50-K.W. Walker M. P. 125 volts, d. c. Russell engine (brand new).
1—43-K.W. Westinghouse M. P. 125 volts, d. c. 11x12 Russell engine.
1—40-K.W. G. E. M. P. 250 volts, d. c. McEwen engine.
1—30-K.W. C. & C. M. P. 125 volts, d. c. 8x12 Atlas engine.
1—25-K.W. Diehl M. P. 125 volts d. c. Ball & Wood.
1—5-K.W. Perritt 110 volts, d. c. Sturtevant double engine.

BOILERS EQUIPMENTS

THOMPSON SON & CO.
HEAD OFFICE
114 LIBERTY ST. N.Y.

110-125 VOLT MOTORS.

2—3-H.P. New England.
1—5-H.P. Kester, multipolar, oil cups.
2—7½-H.P. Edison.
1—7½-H.P. Northern, multipolar.
1—10-H.P. Jenney.
1—10-H.P. C. & C.
1—12-H.P. Eddy, with extra armature.
1—15-H.P. Detroit, oil cups.
1—15-H.P. Eddy.
2—15-H.P. Edison, 12-K.W.
1—18-H.P. King.
1—18-H.P. Commercial.
1—18-H.P. Eddy.
1—18-H.P. T.-H., oil cups.
2—18-H.P. Edison, 15-K.W.
2—20-K.W., Jenney.
1—20-K.W. Commercial.
1—20-H.P. C. & C.
1—20-H.P. Westinghouse, multipolar.
1—25-H.P.T.-H. D. 20, oil cups.
1—25-H.P. Hawkeye, oil cups.
1—25-H.P. C. & C.
1—30-H.P. Commercial.
1—30-H.P. Rockford.
1—35-H.P. Jenney, 30-K.W.
1—35-H.P. Rockford.
5—35-H.P. Edison, 30-K.W.
2—35-H.P. Siemens & Halske.
3—35-H.P. Mather.
1—50-H.P. Rockford.
1—60-H.P. Jenney.
1—60-H.P. Edison, 45-K.W.
1—75-H.P. Edison, 60-K.W.
1—75-H.P. National, M. P.
1—100-H.P. Keystone, multipolar.
1—125-H.P. Triumph, M. P.

220-250 VOLT MOTORS.

1—1-H.P. Jenney.
1—1-H.P. C. & C.
1—1-H.P. Northern, M. P.
1—1-H.P. Towle.
2—1-H.P. New England.
1—3-H.P. Thomson-Houston.

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54-62 S. CLINTON ST. CHICAGO.

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Large stock of Meters, Arc Lamps, Station Instruments and Supplies. All apparatus fully guaranteed in perfect operative condition. Send for Monthly Bargain Sheet with complete list and net prices.

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1—3-H.P. Thresher.
1—3-H.P. Mather, square top.
2—3-H.P. New England.
1—3½-H.P. Card, printing press motor, multipolar, direct connection.
1—4-H.P. Edison.
1—4-H.P. New England.
1—4-H.P. E. & C. multipolar.
1—5-H.P. Westinghouse, M. P., printing press motor, for direct connection.
1—7½-H.P. Sprague, oil cups.
1—7½-H.P. Waddell-Entz.
1—7½-H.P. Northern, multipolar.
1—10-H.P. Gen. Elec., M. P., type C. E.
1—10-H.P. Edison, 8½-K.W.
1—10-H.P. C. & C., M. P.
1—12-H.P. Elec. Mach. Co., multipolar.
1—12-H.P. T.-H., D 10, oil cups.
1—15-H.P. Rockford, iron clad.
1—15-H.P. Card.
1—15-H.P. Eddy.
1—15-H.P. Edison, 12-K.W.
2—20-H.P. Gen. Elec. M. P., type A.
1—20-H.P. Triumph, M. P.
1—25-H.P. Bullock, multipolar.
1—30-H.P. Triumph, M. P.
1—30-H.P. C. & C. multipolar.
1—35-K.W. Edison, 30-K.W.
1—50-H.P. Northern, M. P.
1—60-H.P. Edison, 45-K.W.
1—60-H.P. Northern, M. P.
1—75-H.P. Westinghouse, M. P.

500-550 VOLT MOTORS.

1—1-H.P. Lundell.
2—1-H.P. Detroit.
2—1-H.P. New England.
1—1-H.P. Crocker-Wheeler.
1—1-H.P. New England.
1—1-H.P. General Electric, type C. A.
1—1-H.P. Westinghouse, multipolar.
1—1½-H.P. Akron.
2—1½-H.P. Northern, M. P., series.
1—2-H.P. Detroit, oil cups.
1—2-H.P. C. & C.
1—2-H.P. Thomson-Houston.
1—2-H.P. New England.
1—2-H.P. Wagner.
1—2-H.P. Westinghouse, M. P.
1—3-H.P. General Electric, type C. E.
1—3-H.P. New England.
2—3-H.P. Westinghouse, multipolar.
1—4-H.P. Perrett, M. P.
1—5-H.P. Detroit, oil cups.
1—5-H.P. Thomson-Houston.
1—5-H.P. Triumph, multipolar.
1—6-H.P. Mather, square top.
1—7½-H.P. Wood, new armature.
1—7½-H.P. Eddy.
1—7½-H.P. Ford-Washburn, oil cups.
1—7½-H.P. Excelsior, multipolar, Churchward type.
1—7½-H.P. General Electric, multipolar.
1—10-H.P. Eddy.
1—10-H.P. Edison.
1—10-H.P. Crocker-Wheeler, M. P.
2—10-H.P. Gen. Electric, M. P., "C. E."
1—15-H.P. Perrett, multipolar.
1—18-H.P. C. & C.
1—18-H.P. Thomson-Houston, D. 15.
1—20-H.P. Commercial.
1—20-H.P. Jenney.
1—20-H.P. Eddy.
1—25-H.P. Eddy, multipolar.
1—25-H.P. Jenney.
1—30-H.P. C. & C.
1—30-H.P. Bullock, multipolar.
1—35-H.P. Edison, 30-K.W.
1—40-H.P. C. & C.
1—40-H.P. Wood, multipolar.
1—40-H.P. Bullock, multipolar.
4—60-H.P. Edison, 45-K.W.
1—60-H.P. T.-H., D 50, oil cups.
1—75-H.P. Edison, 60-K.W.
1—100-H.P. Bullock, multipolar.
1—100-H.P. Akron, M. P.
2—110-H.P. General Electric, M. P. 90.
2—125-H.P. Westinghouse, M. P.

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125-133 Cycle. Single-Phase. All 104-215 Volts.

2—½-H.P. Wagner.
1—½-H.P. Stanley.
1—¾-H.P. Emerson.
1—1½-H.P. Wagner.
1—2-H.P. Wagner.
2—2-H.P. Ft. Wayne.
1—5-H.P. Wagner.
1—5-H.P. Ft. Wayne.
1—7½-H.P. Wagner.

Two-Phase. 125-133 Cycles.

4—1-H.P. Stanley, 500 volts.
2—5-H.P. Stanley, 500 volts.

Two-phase. 60 Cycle.

1—1-H.P. Westinghouse, type C, 200 v.
1—3-H.P. Westinghouse, 200 volts.
1—7½-H.P. Westinghouse, type C, 200 v.
1—10-H.P. General Electric, 110 volts.
1—15-H.P. Westinghouse, Type B.

Three-Phase. 60 Cycle.

1—1-H.P. General Electric, 110 volts.
1—3-H.P. General Electric, 110 volts.

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6—Edison, No. 20, 60-K.W. each... $400
6—T. H. D-62, each..... 500
6—Edison, No. 60, 175-K.W..... 1,200
1—Gen. Electric, 100-K.W., 6 pole.. 1,400
2—Gen. Electric, 100-K.W., 4 pole.. 1,200
1—Westinghouse, 175-K.W..... 2,000
1—Gen. Electric, 250-K.W..... 2,250
4—T. H., 270-K.W., arranged to be driven with a single pulley clutch coupling on either side of pulley, per pair..... 5,000
2—T. H., 500-K.W., each..... 4,550

220 VOLT GENERATOR.

1—200-K.W. Triumph 6 pole, new. $2,400

110 VOLT GENERATORS.

2—14-pole, 210-K.W., Gen. Elec. design, for a direct connection, at a speed of 120 r.p.m.,each. $2,250

ARC LIGHT GENERATORS

10—No. 10, 100-Light, 9.6 Ampere Brush Arc Dynamos, with oil regulators, practicaly n'w each. $900
1—750-K.W. Westinghouse 60-Cycle, 2-Phase, 2200 Volt Generator, belted to one 24 and 48 x 60 cross-compound condensing Cooper Corliss engine, complete $25,000

ALTERNATING GENERATORS

1—35-K.W. Westinghouse, with exciter and switchboard instruments, 1100 volts $300
1—60-K.W. Westinghouse, without exciter and switchboard instruments, 1100 volts..... 300
2—100-K.W. G. E. mono-cyclic, with exciter and switchboard instruments complete, 1100 volts.... 1,200
2—180-K.W. Stanley, 1100 or 2200 volts, with exciter and switch board instruments, each..... 1,500

MOTORS

200—New 25-H.P. Motors, complete with pinion, gear and gear cases, each..... $250

CONTROLLERS

100—"K" Controllers, each..... $60
25—K-2 Controllers, each..... 70

ENGINES

1—Tandem Compound Ball, 8 and 13 x 12..... $800
2—Tandem Compound Balls, 9 and 16 x 12, each.....$1,000
4—Russel Automatic, 15 x 20 each. 700
2—Porter-Allen, 16 x 20, each.... 1,000
1—11 and 17 x 14, Cross-Compound Ideal 1,400
2—21 x 18 Armington & Sims, each. 1,500
1—Porten-Allen, 21 x 36..... 1,500
1—Porten-Allen, 28 x 42..... 4,000
1—Hamilton-Corliss, 14 x 42..... 1,500
1—St. Louis Corliss, 30 x 54..... 5,000
1—Penn. Iron Works Corliss, 28 x 60 4,500
2—Lane & Bodley, 24 x 60, designed for Rolling Mill work, for the pair 8,500
1—20 x 48 Wheelock..... 2,250
1—Double Wheelock, 20 x 48..... 4,000
1—Wheelock, 20 x 42..... 2,000
1—Armington & Sims, 13 x 12.... 400
1—Taylor-Beck, 12 x 14..... 300
1—Houston, Stanwood & Gamble, Cross-Compound, 16 and 22 x 22 1,250
1—Cooper Cross-Compound, Non-Condensing, 36 and 60 x 60, n'w, never having been shipped from the factory $32,000
1—Tandem Compound Ball, 12 and 20 x 16 1,500
3—Skinner engines, 17 x 18, with air compressing cylinders attached, each 750

BOILERS

4—72 in. x 16 ft. tubular boilers, with 72 4-in. tubes, each..... $450
4—66 in. x 18 ft., with 66 4-in. tubes, each 450
3—66 in. x 14 ft., with 66 4-in. tubes 350
1—72 in x 18 ft., with 66 4-in. tubes, each 450
2—Sterling water-tube, each 350-H.P., per H.P. 5
2—Hazleton, 500-H.P., per H.P.... 1
2—Clark, 150-H.P. water-tube boilers, per H.P 6

Will exchange any of the above list of apparatus for any other kind of apparatus. Let me known your requirements.

I have seven complete Power Houses for sale, and believe I can make it to your interest to see me.

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60-CYCLE ALTERNATORS.

150-K.W. Fort Wayne Wood alternator, either 1100 or 2200 volts, W. A. L. type, compound wound, complete with exciter and instruments.
2—150-K.W. three phase, Stanley alternators, 2750 or 5500 volts.
2—200-K.W. two phase Stanley alternators, 2750 or 5500 volts.
1—120-K.W. General Electric, A. S. type, 1100 or 2200 volts; December delivery.
2—120-K.W. General Electric, 133 cycle, 1000 volt alternators.
1—175-K.W. Edison bi-polar railway generator.
3—100-K.W. Edison bi-polar 140 volt generators.
1—45-K.W. Edison bi-polar 140 volt generator.
1—30-K.W. Westinghouse 110 volt direct connected unit with engine.
1—72x16 tubular boiler, 100 lbs., Hartford.

CORLISS ENGINES.

500-H.P. Corliss engine, 16 and 30x48 Cross compound Condensing Cooper Corliss, complete with independent air pump and condenser; heavy sectional wheel 20 feet diameter with 37 inch face. As good as new. Immediate delivery.
375-H.P. 16x42 Twin Cooper Condensing Corliss, with Cooper Condenser.
High speed automatics, from 250-H.P. down.

Write us for stock list of Station Equipments and accessories.

FOR SALE

110 VOLT GENERATORS.

2—1100 LIGHT, 65 K. W. JENNY.
1—1000 LIGHT, 60 K. W. SIEMENS & HALSKE.
2—1100 LIGHT 60 K. W. THOMPSON-RYAN, 10 POLE.
1—1000 LIGHT, 50 K. W. T. & H.

133 CYCLE ALTERNATORS.

1—120 K. W. SLATTERY, 1100 VOLT.
1—100 K. W. SLATTERY 1100 VOLT.
1—100 K. W. WESTINGHOUSE, 1100 VOLT.
1—70 K. W. T. & H. 1100 VOLT.
1—60 K. W. GENERAL ELECTRIC, 100 VOLT
1—50 K. W. T. & H. 100 VOLT.

ILLINOIS MAINTENANCE COMPANY,
1625 Marquette Bldg., Chicago.

FOR SALE

1—50-light, 9½ ampere Westinghouse arc dynamo.
1—Brush 68 arc dynamo.
1—30-light Schuyler arc dynamo.
1—45-light Schuyler arc dynamo.
3—50-K.W. Westinghouse alternators, 1000 v.
1—60-K.W. Slattery alternator, 1000 v.
1—1100 voltage, 26 ampere Royal alternator.
1—65-light Weston multipolar generator.
1—35-light 110-v. generator.
1—20-K.W. 500-volt Edison generator.
2—20-K.W. T. & H. 50-v. generator.
3—Standard Weston 300-light machines.
1—200-light Huber 110-v. dynamo.
2—500-light T. & H. 110-v. dynamo.

ALSO FOR SALE

1—complete 900-light capacity electrical plant, consisting of 12x16 automatic Walker engine, 3 300-light machines, 1 Knowles steam pump, belting, drive pulley, floor stands, switchboard and all fixtures and trimmings, ready to put into operation.

ALSO FOR IMMEDIATE DELIVERY

1—30x60 Fraser & Chalmers Corliss engine with fly wheel 18 ft. dia.x44 in. face, complete and in first-class order.

We have all kinds of engines, boilers, pumps and machinery in general. Write for our catalogue No. 220.

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West 35th and Iron Sts., - CHICAGO, ILL.

QUICK SHIPMENT BARGAINS.

1—12x12 Harrisburg Ideal Engine. Automatic, with iron sub-base, practically new. Wheels 72x12 .....$550.00
Code "Ideal."
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The above are complete with Foundation Bolts, Oil Cups and Lubricators and are delivered f.o.b. New York City.

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For Sale at a Bargain

Twenty No. 10 Multi Circuit Brush Dynamos, 9.6 Amperes. Now in operation at The Cincinnati Gas & Electric Light Co. Will sell or exchange for other electrical machinery.

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12x36 Hamilton Corliss.
12x24 Sioux Corliss.
24x48 Buckeye Automatic.
18x24 Allis Heavy Duty Automatic.
11½x14 Taylor-Beck Automatic.

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Two 150-H.P. Babcock and Wilcox Water Tube Boilers.
Five 72x18 horizontal tubular 125 lbs.
One Geary Water Tube Boiler, 175 H. P. for 150 lbs. pressure, almost new.
Two 60x18 Horizontal Tubular.
Four 60x16 Horizontal Tubular.
One 56x16 Horizontal Tubular.
One 48x16 Horizontal Tubular.
600 H. P. Berryman Heater.
125 H. P. Berryman Heater.
500 H. P. Excelsior Heater.
6x4x6 and 5¼x3½x5 Worthington Pumps.
Full line Marsh Pumps, new.

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Dynamos, Motors, Engines, Boilers,

ETC., BOUGHT, SOLD & EXCHANGED

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BARGAINS
FOR IMMEDIATE DELIVERY.

2—150 K.W. 125 Volt Western Electric 225 R. P.M., for direct connection —Brand New.
1—150 Light 9.6 amp. Wood Arc Dynamo.
2—75 K. W. Stanley, 2 phase, 125 cycle.
1—50 K. W. 125 Volt 4 Pole Wagner.
1—62 K. W. 500 Volt T. H.

Large stock of First Class Dynamos and Motors. Write for List.

SCHUREMAN & HAYDEN,
133-139 S. CLINTON STREET. CHICAGO.

ELECTRICAL AND STEAM MACHINERY

Railway Generators

DIRECT CONNECTED

2—850-kw Type, M. P. 12-850-80. General Electric, each direct connected to a 32 and 52x48 cross compound Penn. Iron Works Engine. Speed 80 R. P. M.

1—600-kw Westinghouse Generator, direct connected to a 18 and 38x42 cross compound St. Louis Iron and Mach. Works Corliss Engine. Speed 100 R. P. M. Brand New.

1—525-kw Type M. P. 10-525-90 General Electric, direct connected to a 22 and 42x42 Corliss Engine. Speed 90 R. P. M. Brand New.

1—200-kw Siemens & Halske M. P. Generator direct connected to a 20x20 Columbus Iron Works high speed auto. engine. Speed 200 R. P. M.

Complete Belted Units

1—500-kw Type M. P. 4-500-350, operated by a 28"x60 E. P. Allis engine with "1890 Frame."

1—200-kw Type M. P. 4-200-425; operated by a 20x42 Hewes & Phillips Corliss Engine.

Railway Motors

150—38 B. Westinghouse.
100—49 Westinghouse.
175—12 A Westinghouse.
25—68 Westinghouse.
30—69 Westinghouse.
10—G. E. 52.
10—G. E. 800.
100—No. 3 Westinghouse.
K, K2, K10, K11, K12, Controllers.

RAILWAY GENERATORS

Belted

2—500-kw Westinghouse, M. P.
1—500-kw General Electric, M. P.
1—300-kw General Electric, M. P.
1—250-kw Walker, M. P.
1—225-kw General Electric, M. P.
4—200-kw General Electric, M. P.
1—200-kw Westinghouse, M. P.
2—100-kw General Electric, M. P.
1—100-kw Westinghouse, M. P. 6.
1—100-kw Siemens-Halske, M. P.
2—150-kw Ft. Wayne, M. P. 6.
1—200-kw Edison.
1—60-kw Edison, Bipolar, M. P.
1—75-kw Thomson-Houston.
6—D62 Thomson-Houston.

EXTRA ARMATURES

1—200-kw Edison, 500 volts.
1—150-kw Edison, 110 volts.
1—100-kw Edison, 500 volts.
2—60-kw Edison, 500 volts.
2—60-kw Edison, 110 volts.
1—25-kw Edison, 110 volts.
1—15-kw Edison, 110 volts.
1—12-kw Edison, 110 volts.
1—10-kw Edison, 110 volts.
1—A120 T.-H. alternating toothed style.
6—T.-H. M. D. 2-Arc Armatures of ring type.
2—No. 8 Brush Arc Armatures. 9.6 Amp.

BELTED DYNAMOS AND MOTORS

110 Volts

4—100-kw M. P. Eddy.
2—100-kw Edison.
2—75-kw M. P. Westinghouse.
2—60-kw Edison.
1—45-kw Edison.
1—25-kw Edison.
1—50-kw Siemens & Halske.
1—30-H.P. Westinghouse, M. P.
1—15-H.P. Excelsior.
1—8-kw Mather.
1—10-H.P. M. P. Excelsior.
1—10-H.P. Bipolar Excelsior.
1—5-H.P. Thomson-Houston.
1—25-amp. Westinghouse.
1—10-amp. Westinghouse.
1—3-kw Mather.
1—21-amp. Ft. Wayne.
1—2-H.P. Excelsior.

BELTED DYNAMOS AND MOTORS

220 Volts

1—240-kw M. P. Walker.
2—80-kw M. P. C. & C.
1—75-H.P. M. P. C. & C.
1—56-kw Westinghouse, M. P.
1—D20-kw Thomson-Houston.
1—40-H.P. Hobart.
1—25-H.P. C. & C.
1—25-H.P. Eddy.
1—15-H.P. Perret.
1—15-H.P. Excelsior.
1—12-H.P. C. & C.
1—10-H.P. Thomson-Houston.
1—8½-kw Edison.
1—8-kw Mather.
1—8-H.P. Excelsior.
1—3-H.P. Excelsior.
1—2½-H.P. Ft. Wayne.
1—15-kw Siemens & Halske, for direct connection.

BELTED MOTORS

500 Volts

1—100-H.P. M. P. General Electric.
2—60-kw Edison.
1—25-H.P. C. & C.
1—15-H.P. T.-H.
1—20-H.P. Westinghouse.
1—12-H.P. C. & C.
1—10-H.P. Mather.
1—10-H.P. T.-H.
1—7½-H.P. Card.
1—7½-H.P. C. & C.
1—10-H.P. General Electric.
1—5-H.P. C. & C.
1—5-H.P. T.-H.
1—3-H.P. General Electric.
1—3-H.P. Belknap.
1—3-H.P. Crocker-Wheeler.
1—3-H.P. T.-H.
1—2-H.-P. Belknap.
1—2-H.P. General Electric.
1—¼-H.P. Detroit.

ARC DYNAMOS

2—165-light, multi-circuit Brush, No. 12 6.8 amp.
2—125-light, multicircuit Brush, 2,000 C. P. No. 12.
1—120-light, multi-circuit Brush, 1,200 C. P. No. 9.
1—80-light multi-circuit Brush, 2,000 C. P. No. 9.
2—M. D. 12, 75-light, Thomson-Houston arc dynamos.
4—M. D. 2, 50-light, Thomson-Houston arc dynamos.
2—L. D. 12, 50-light Thomson-Houston arc dynamos.
4—M. 2, 45-light, Thomson-Houston arc dynamos.
3—No. 8, 65-light, 2,000 candle power Brush.

ALTERNATORS

Single Phase

1—250-kw Westinghouse, 1100 volts, 120 cycle.
2—150-kw Ft. Wayne, 1040 volts, 120 cycle, 700 R. P. M.
2—A120 General Electric, single-phase, 1,000 volts, 16,000 alternations.
1—120-kw Westinghouse, 1100 volts, 16,000 alternations, toothed arm.
2—A100 T.-H., single-phase, 1100 volts, 16,000 alternations.
1—100-kw Fort Wayne, 2200 volts, 16,000 alternations.
3—70-kw T.-H., self-oiling, 120 cycle, 1050 volts.
2—60-kw General Electric, single-phase, 1100 volts, 16,000 alternations.
2—60-kw Westinghouse, single-phase, 16,000 alternations, 1,100 volts.
1—45-kw Westinghouse, 2,200 volts, 16,000 alternations.
1—45-kw Westinghouse, 2,200 volts, 7,200 alternations.
2—A35 General Electric, single-phase, 16,000 alternations, 1,050 volts.
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1—120-kw General Electric, 2-phase, 60-cycle, 2,200 volt.
1—75-kw Stanley 2000-1000 volts, 2-phase, 16,000 alternations.
1—75-kw General Electric, 2-phase, 60 cycle, 2,200 volts.
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1—16&26x17 Tandem McIntosh & Seymour.
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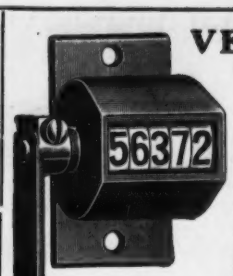

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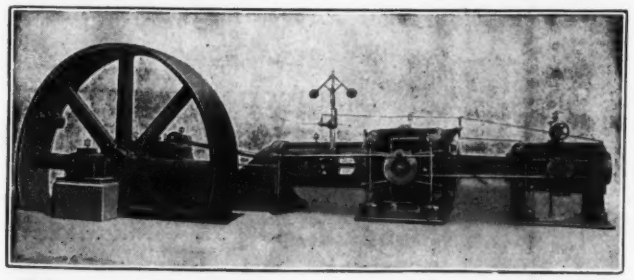

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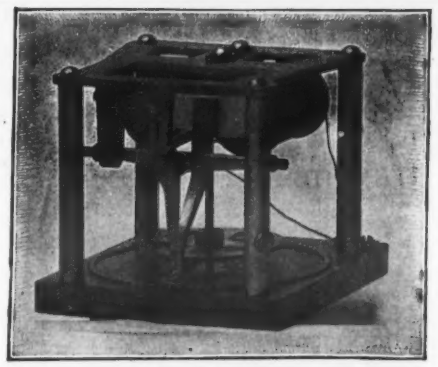

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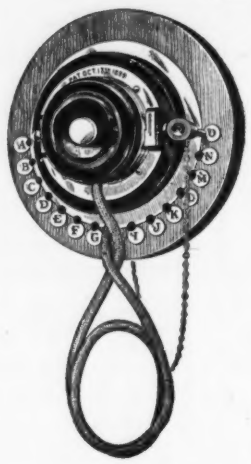

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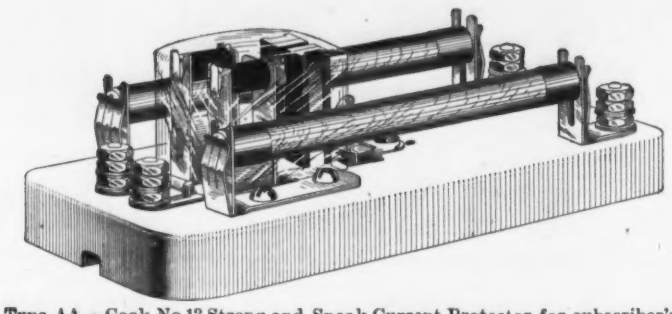

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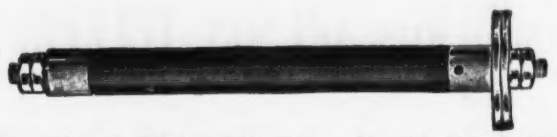

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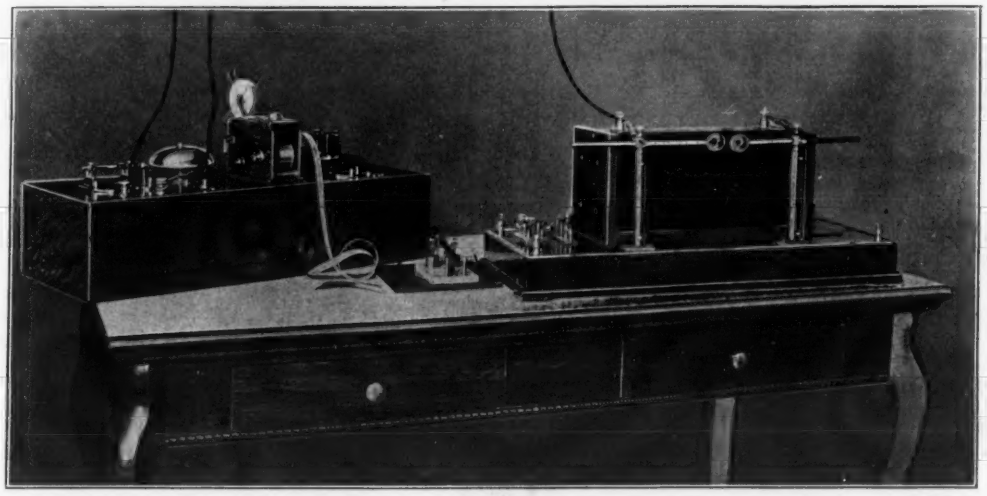

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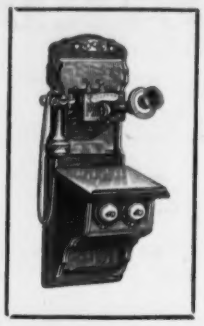
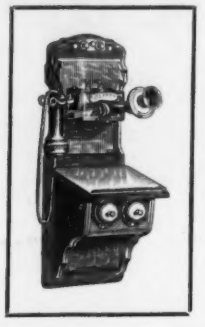


TELEPHONES



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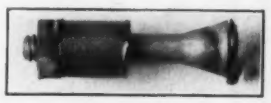

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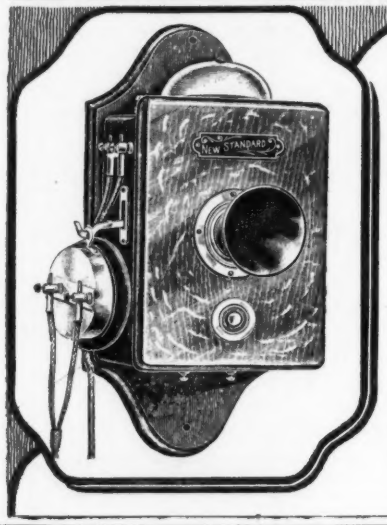

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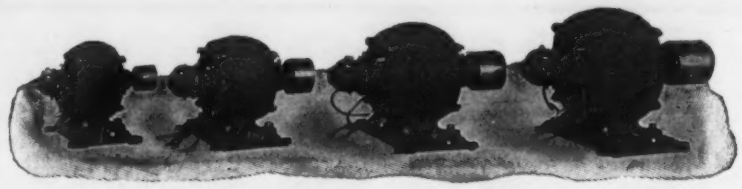

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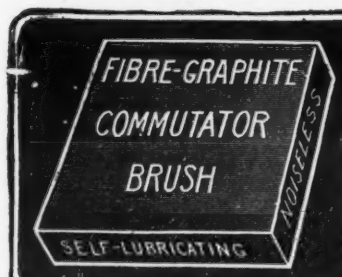

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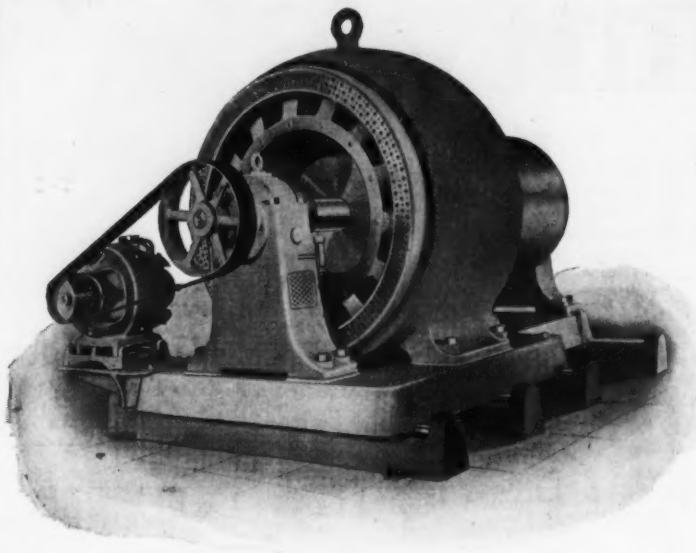

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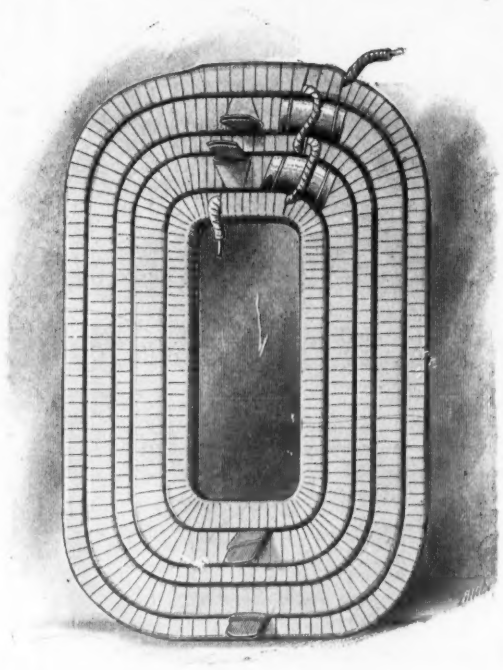

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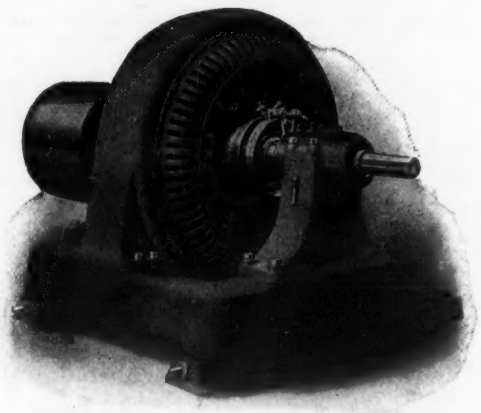

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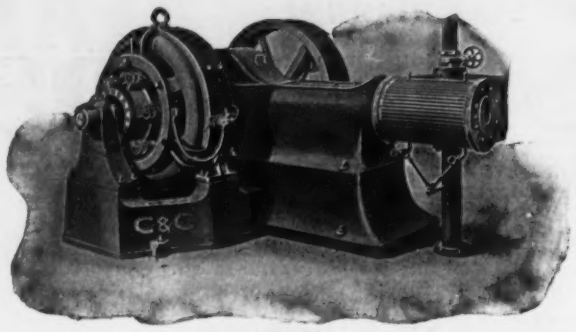

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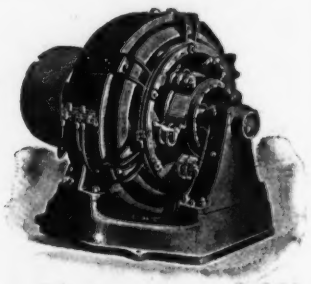

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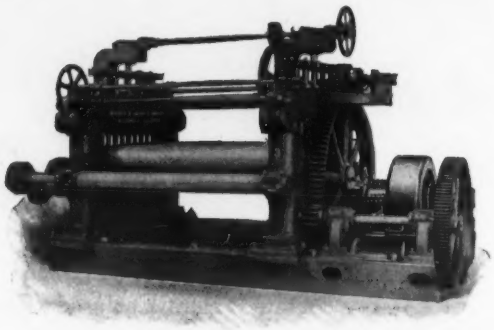

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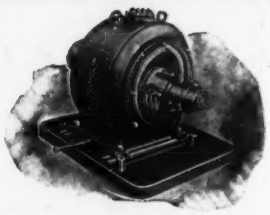

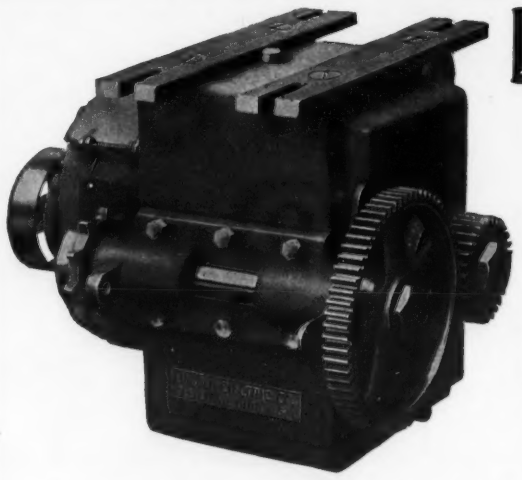

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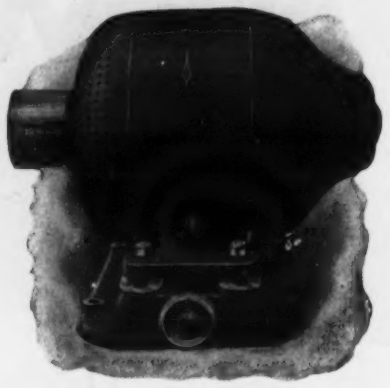

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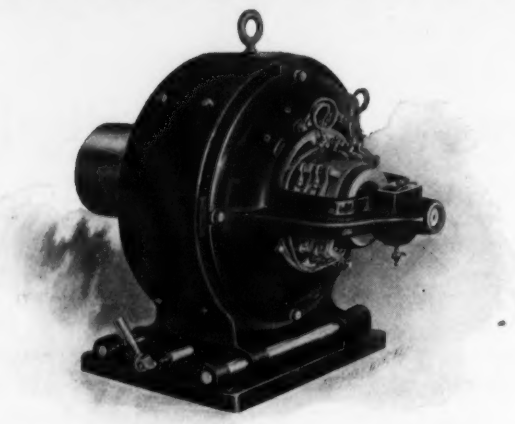

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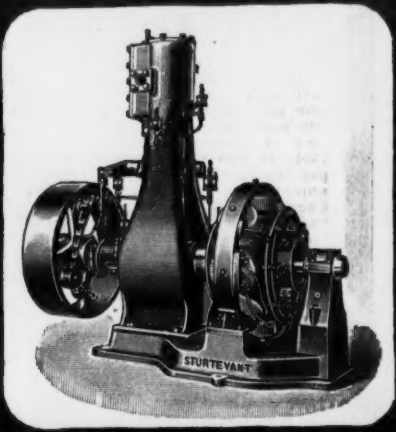

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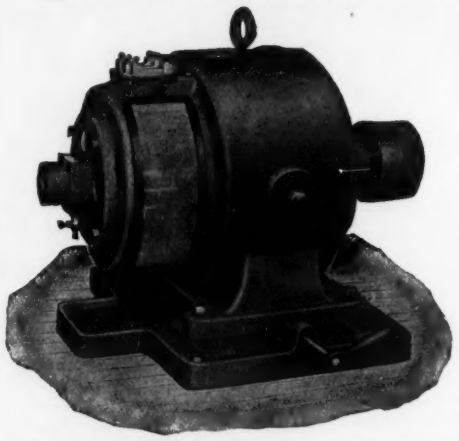

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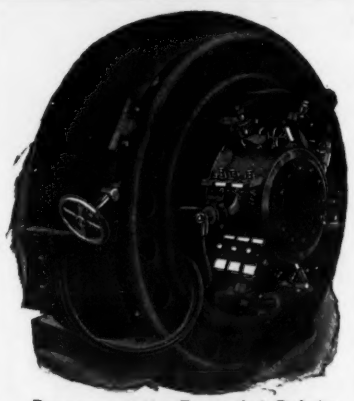

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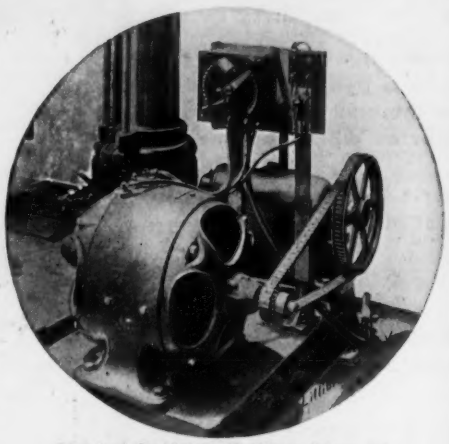

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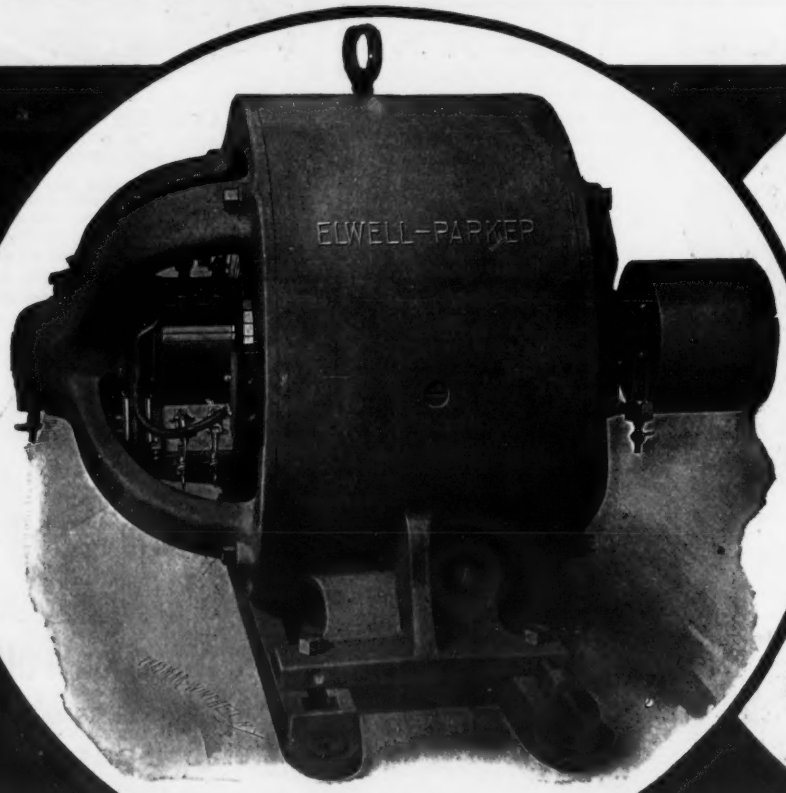

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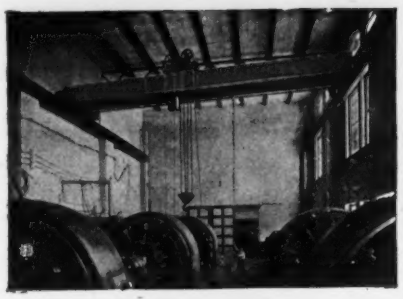

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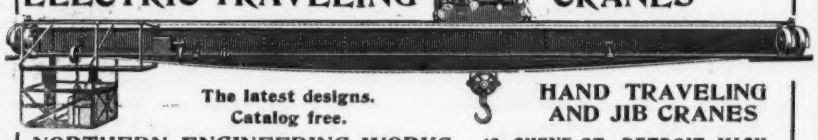

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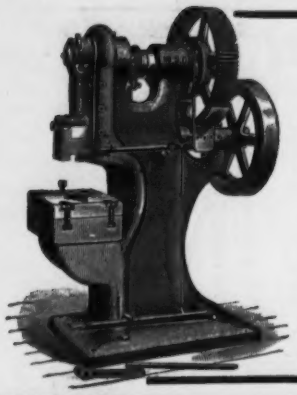

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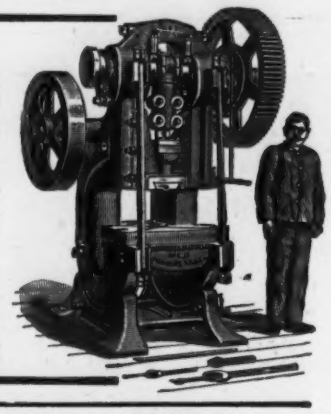

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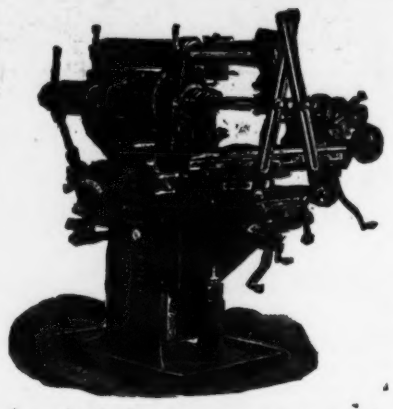

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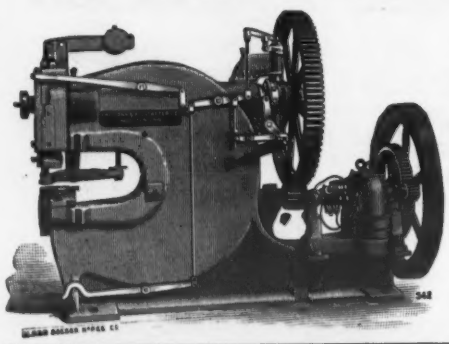

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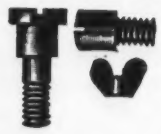

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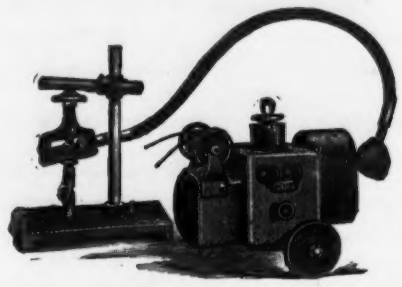

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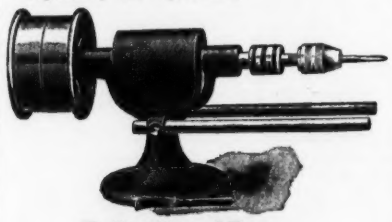

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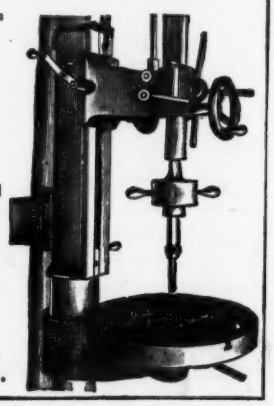

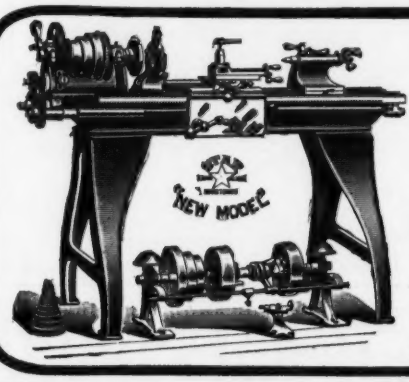

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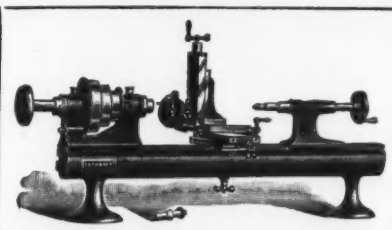

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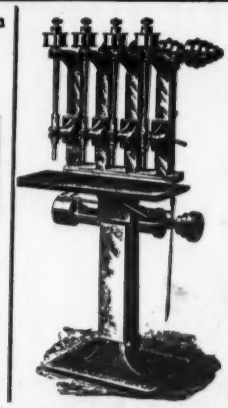

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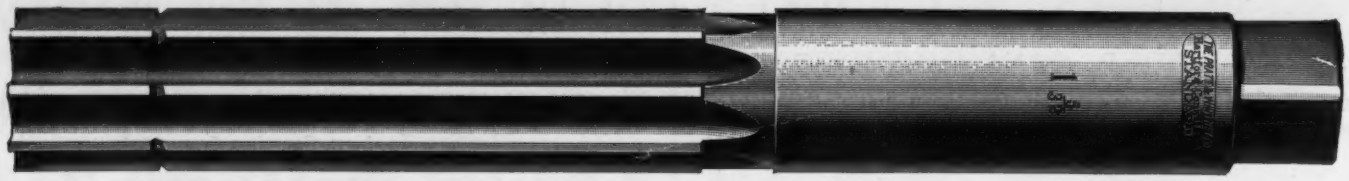

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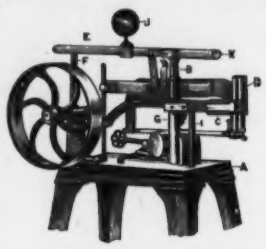

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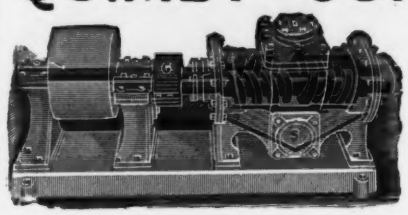

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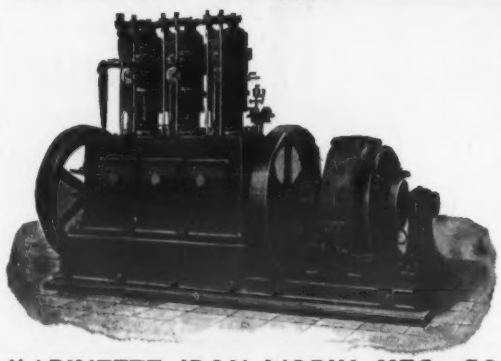

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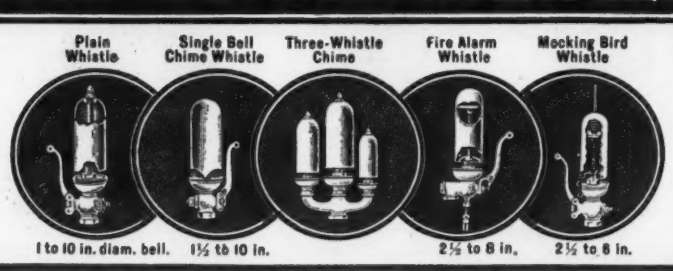

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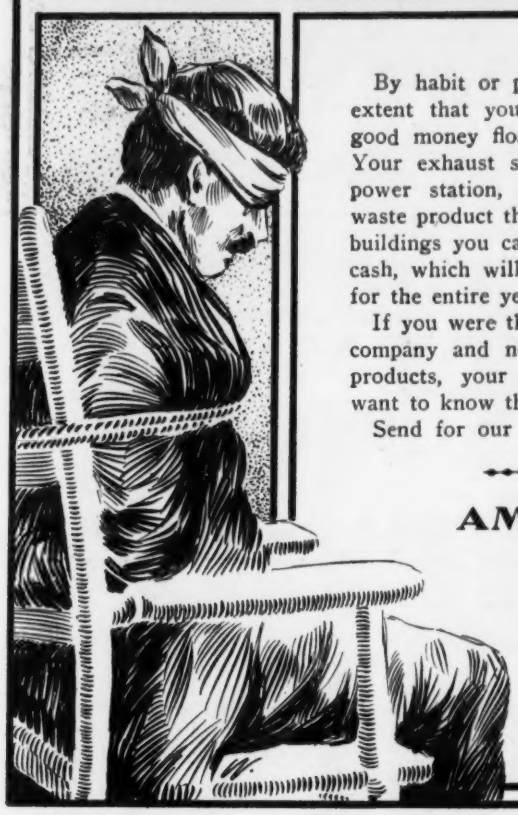

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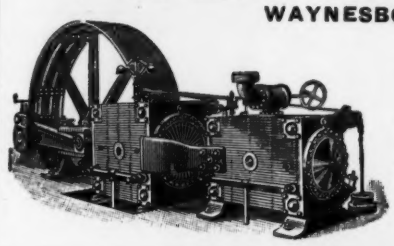

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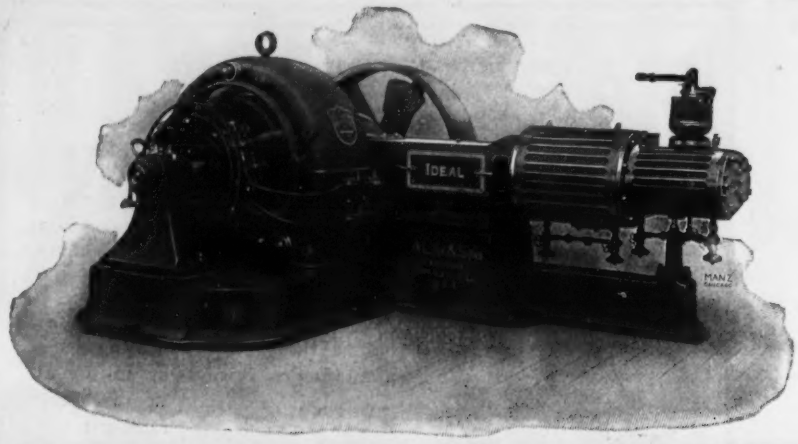

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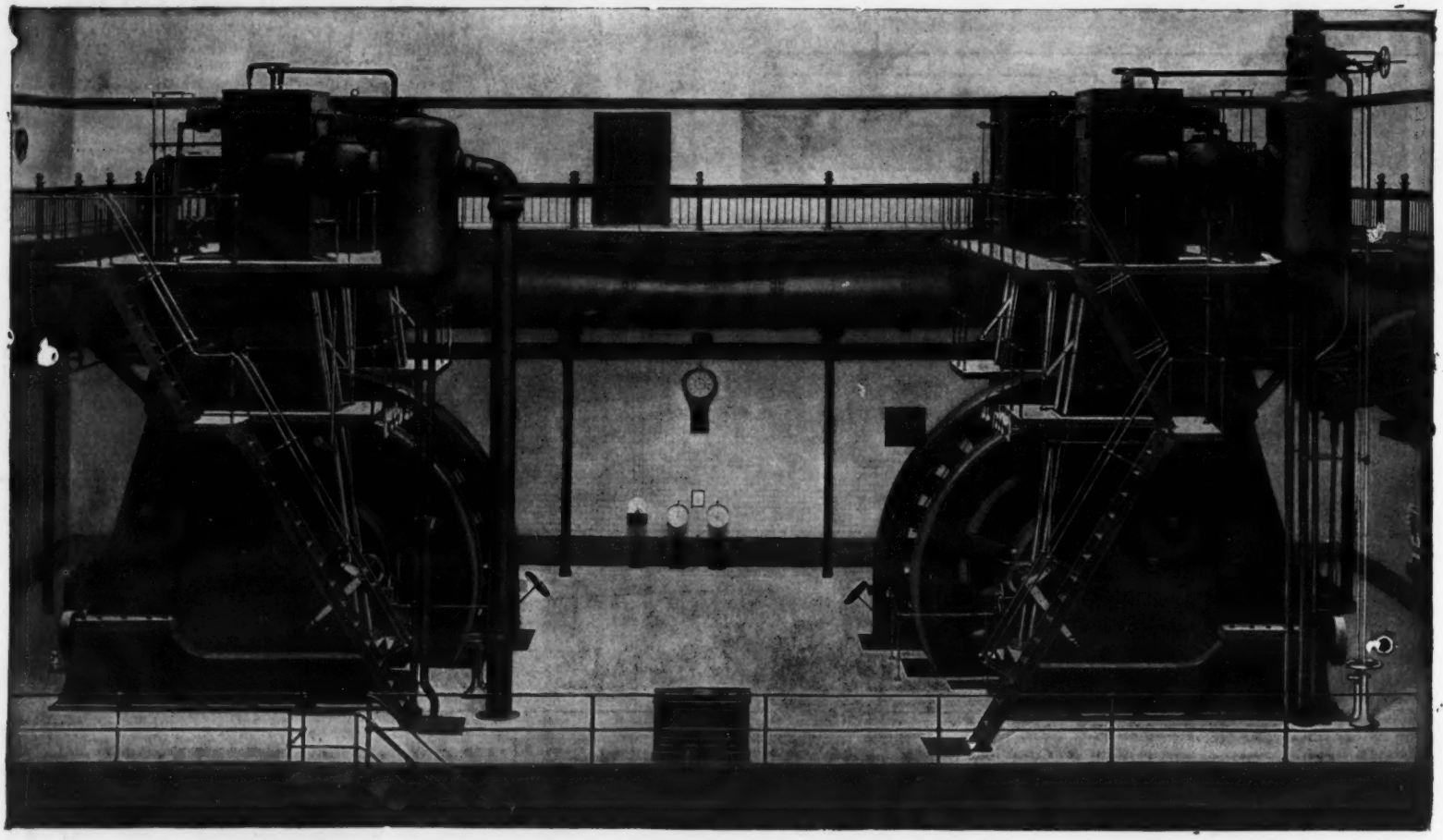

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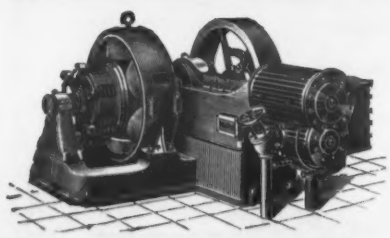

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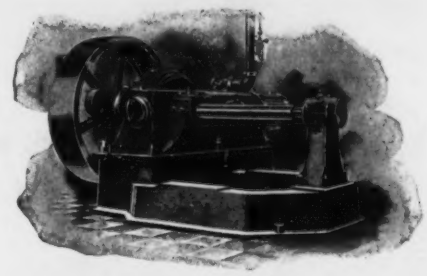

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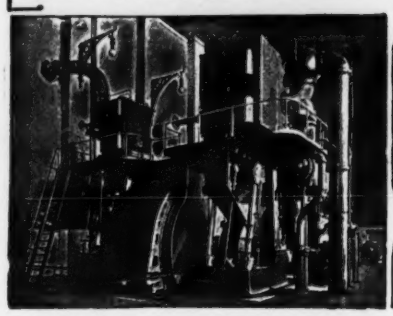

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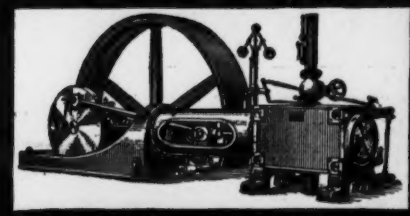

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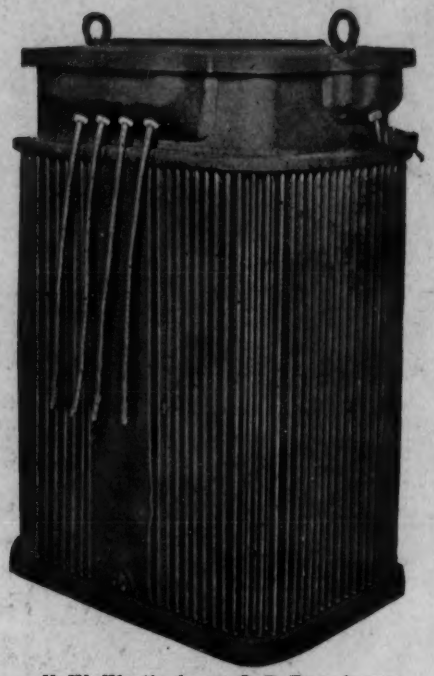

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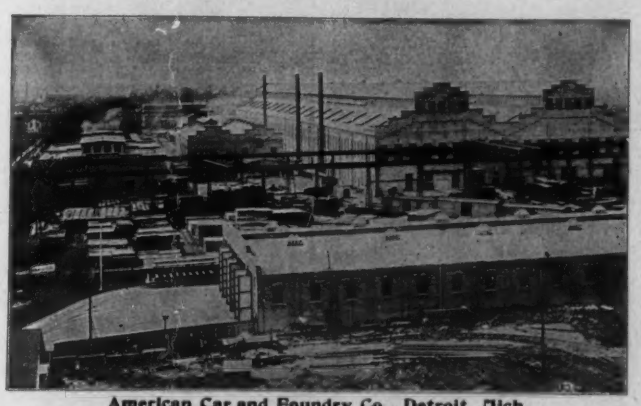

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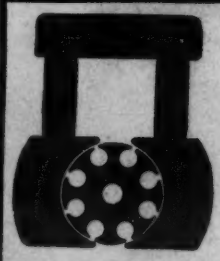

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